FACTORS INFLUENCING THE USE OF PLANT MATERIAL TO DEVELOP A FUNCTIONAL REGIONAL LANDSCAPE IN THE GREAT PLAINS

by

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"Man is a singular creature. He has a set of gifts which make him unique among the animals: so that unlike them, he is not a figure in the landscape--he is a shaper of the landscape. In body and in mind he is the explorer of nature, the ubiquitous animal, who did not find but has made his home in every continent."

J. Bronowski

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I dedicate the hard work to carry out this dissertation to my parents. They have made it many times possible to go on and I really thank them for it. The end result, the dissertation, I dedicate to Anneke, my wife, who has lived with me through all the ups and downs. I hope that for many years we may share the fruits of this labor.

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PREFACE

The purpose of this study is (1) to show how the natural landscape of one region evolved over a long period of time through natural processes and has then been modified in a relatively short period of time by man into a cultural landscape, (2) to show that with understanding and appreciation of the processes involved such landscapes can be used as a basis to restore and maintain a functional regional landscape, and (3) to provide a summary of information for people responsible for our landscape so that their efforts will result in a regional landscape for generations to come.

In its entirety, this study will attempt to show that a positive relationship exists between the development of a natural landscape and its humanization by man, and that optimum landscaping can provide an ecologically sound and esthetically pleasing landscape, whether it be large scale, regional, small scale park or even garden.

The study begins with an introduction to the two main concepts of landscape which have been used: the relationship between natural and cultural landscape, and the three modes of perception by means of which man perceives his landscape as real. On the basis of those concepts the evolution of the natural and cultural landscapes of the Great Plains are described in the second and third chapters; these chapters also involve the first two modes of perception, the historical and the functional. The fourth chapter outlines principles of landscape design in the Great Plains, using what is called, in this dissertation, the third or conservative mode of perception; it deals with a possible future. This possibility is explored in the fifth chapter, a case study of Kansas, ending with an inquiry into the practical feasibility of national landscape parks. The dissertation is concluded in the sixth chapter with a theoretical outline of the methodology for creating a functional landscape which incorporates the historical and conservation modes of perception in the present functional cultural landscape.

The intention of the study is to show what a practicing landscaper--be he gardener, engineer, architect, designer--needs to learn from the landscape scientist so that his practice is based on the best theoretical or scientific knowledge available. In its way, the dissertation might serve as both a handbook for the practicing landscaper and a textbook for the teaching of the science of landscape. The author acknowledges that neither of these ambitions have been achieved here but an understanding of what both such a handbook and textbook might contain is conveyed in the dissertation.

The general argument of the premise of the dissertation may be summed up as follows: The function of landscaping is to balance the historical and conservative perceptions of nature against the immediate functional view of or attitude to it; that function is best performed, and that balance best achieved by identifying and maintaining the esthetic qualities of a landscape because, although esthetic perceptions are the most difficult to justify, esthetic appreciation is the strongest brake on the damage possible in a solely functional perception of the landscape; but esthetics must be based on a deep scientific knowledge of the landscape in order to avoid fruitless confrontation between obvious need and shallow objections on the grounds of "beauty." The key to conservation is therefore the scientifically informed attitude towards landscape which this dissertation is intended to cultivate.

Throughout the dissertation the words "landscaping" and "landscaper" have been used. Some people hold the view that "landscape development" and "landscape developer" are both more indicative and are more commonly used. I have chosen to retain both "landscaping" and "landscaper" to clearly distinguish between landscaping efforts in the Great Plains carried out by the Plains people themselves and landscape development carried out through a major land development project. The Random House dictionary defines landscaping--"to improve the appearance of an area of land as with planting or altering the contours."

The word "landscaper" has been retained because with "landscape developer" one generally thinks of someone who holds a degree in landscape, architecture, landscape planning or related discipline. This, however is generally not the case with the landscaper of the Great Plains, hence the continued use of the word landscaper.

Similarly I have preferred to use the term native plant material which is more readily understood than the more scientific word indigenous plant material. I have done this purposefully since it is my hope that this dissertation will be read by all who undertake to be landscapers of the Great Plains.

CHAPTER I

THEORY OF LANDSCAPE

> In beginning the study of landscapes the novice will find it necessary to acquire all the knowledge which enters into the imaginative impressions the scene is to yield him. The evidence of the slow changes which have brought the bit of earth to its existing form, which have shaped the face while it turns to the eyes of man has to be gained by deliberate inquiry so that the reading is as that of a great volume in its difficulty and in the time it demands.
>
> (N.S. Shaler--Atlantic Monthly, 1808)

Landscaping is not merely the planting of a tree or shrub but should be an inclusive approach to tie an area in with what is, or was characteristically natural for the particular region. The principle of establishing a sound landscape through an understanding of where attractive and characteristic landscapes have originated from is both necessary and helpful, especially when so many people with different interests, backgrounds and experience are involved. The delineation of the principles along which the development of a landscape has evolved, once understood and appreciated, will provide a rationale so that restoration and continued development will be assured of ecological soundness. As a result, the overall development would be guided by the principles established.

For most of us landscaping, however, is the planting of a tree or shrub. This is a response to two related human impulses--to tamper with the natural landscape, and to tamper with it with a primary aim in view: beautification. Indeed, the act of planting a shrub indicates the two principles on which this study is based that human beings recognize two kinds of landscape, natural and cultural, and that they perceive both in three related ways which in effect relate the two kinds together.

1. The Fundamental relationship between the two Landscapes:

Natural landscape is converted by man into a cultural landscape. The land has existed for millenia without man and can again exist without him. Man cannot exist without the land nor can he resist altering its natural appearance for the needs of his culture. There are thus two landscape architects at work all the time in most parts of the world--nature and culture--and each must work with the same materials in different ways according to its own propensity. The natural landscape exists all over the face of the globe and the cultural landscape has to be imposed on it. This imposition is called "landscaping" in its largest sense (at the conclusion of this chapter the term "gardening" is used for the act of imposition of one on the other). Of all the different aspects of human gardening or cultural landscaping, this study concentrates on the use of plant material in one specific region, the Great Plains.

But the distinction man can make between natural and cultural landscape--as when he decides to visit a National Park--is only the beginning of his perception of the relationship between the two landscapes.

2. Theory of Perception:

Man assesses nature by the three ways he looks at the world. The first is coerced by our history. Each of us inherits attitudes from our culture so that contemporary perceptions are in part conditioned by forces that have shaped and evaluated the environment in past times. In other words, we perceive the present through the eyes of the past. Secondly, we look to nature to satisfy our immediate needs and preferences. This is a functional view of nature. Thirdly we envision the environment in terms of its future. This is the conservationist's view and, in the long run, it is the only valid way of recognizing the historical and realizing the functional aspects of the environment. For this last aspect cannot succeed without taking into consideration the historical factors that have influnced man's assessments of the natural world, nor can it ignore man's environmental needs. Indeed, if we are to take seriously man's cultural landscape, we must be true to each of these three interrelated aspects. If we are in a period of renewed awareness of the man-nature interdependency of the whole ecosystem, then we must admit our interdependence with the environment in which we live.

Reality is constructed by each individual; his environment is the raw material out of which he fashions his view of the world. Such a view is influenced by the values and attitudes an individual holds and in the manner in which he intends to use the environment. Many of the participants in the environmental movements are those persons who live in or who belong to the higher cultural and economic levels in society. These are the professionals--government workers, scientists, and teachers. They perceive the environment in terms of abstract desire and on the basis of their general knowledge of the best that is possible. Social scientists have found that people with higher than average income and education have a more considerate attitude toward the natural environment and demonstrate a greater concern for its ecological values than persons of limited education and lower income. They share the chief factors influencing one's attitude toward the environment: motivational drive, intelligence, and psychological stability. Thus it seems clear that cultural conditioning that shapes one's value system can improve one's behavior towards the environment (8-34).

Western man has always tended to accept the natural environment as a given subject for human control although independent of human existence. We make our place in nature but are not necessarily a part of nature. We are more likely to adapt nature to ourselves than the reverse. This Western, scientifically-oriented tradition is one of prediction and control, leading to utility. It stresses the functional at the expense of the historical and conservative ways of seeing nature. And it induces stress in modern man.

Man obtains from his environment two related things which he desires but cannot get by technological expertise alone--utility and beauty. Either can be got by technology but not the right relation between them. All progress in civilization has consisted in man's modification of his surroundings to serve both these needs. There is a very real and pressing demand for the utilization of the landscape by man not just for economic use nor primarily to delight himself with use of land as a kind of show place, but to serve as a relief and antidote to the too-great insistence of his own affairs and his own constructions. Lacking that relief, man is under stress. Many of modern man's mental and emotional maladjustments, his feelings of alienation, and even many of his physical disorders are the after-effects of his adaptation to stress. Stress has been defined as the unpleasant physiological and psychological reactions of the person to new, demanding and often persistent stimuli. Certain forms of high blood pressure and coronary disease have a higher incidence among individuals who have adapted to the tensions of modern living than among those for whom such adaptations have not been necessary. Stress is seen as a non-specific response by the body to the demands made upon it, because man has outgrown his early adaptation patterns of "fight or flight" (8-263).

The fact that industrial societies often no longer reflect the true needs of their inhabitants should be our concern. Many of us suspect that something is wrong with a society that provides so much in a material sense and yet leaves many vaguely dissatisfied with their lives. To change only the environment does not necessarily improve chances for a better life because that amounts only to more functional changes. Any change can and must be made in terms of long-range human consequences, using conservationist and historical as well as functional perceptions.

The most obvious example of stress is city life, a relatively new human phenomenon. Demographically, the urban and suburbanizing trend is a direct result of the industrial revolution. Prior to 1800 there were no urban societies as we know them today, and only one had come into existence by 1900 in Great Britain. Whereas 7 cities in the world numbered half a million inhabitants or more in 1800, 42 had achieved this size by 1900 and today there are more than 200 (8-245).

Today more than 70 percent of the population of the United States lives in cities or suburbs compared to 6 percent in 1800. In Europe, including the Soviet Union, the urban population grew two and a half times between 1900 and 1950. One-fifth of the American nation--40 million people, now live on 1.8 percent of the land of the continental United States (8-245).

In the city the stabilizing influence of a given environment is lost through an accelerating technology that makes each day truly 'new' in some respects and because the tempo of life is increased. Dissatisfaction with city life can be expressed by moving. People change locales for jobs, climate, or esthetic reasons. For many people such movement has very positive values, but it also can be culturally disorientating.

Nelson refers to this as the grief syndrome in relation to place identity (28-198). The phenomenon has much to do with the dissolution of social networks, but environmentally it also reflects the importance of places in which networks operate--front stoop, local shops, the street corner, the country road, a tree, the town entrance, the living room in which family and friends are entertained. The function of these places is to distill themselves into symbolic as well as functional meanings, and to become interwoven with the person and the place relationships sustained over years. Significant objects in one's life, such as a stable home and neighborhood as well as enduring personal relations contribute not only to the sense of "who I am" but to where "I am going" and to "where I have been." This is difficult in an era of upward mobility, where permanent aspects of one's life are continually changing (8-199).

But the city takes its own revenge on movement. Environmental distinctions are becoming less obvious along our highways in a fluid and homogeneous society as a result of easy transportation, mass communication and a country-wide and sometimes international-wide similarity of social customs and design aspects, all formulated in the city. The Kroger stores of similar design built across the nation homogenize the landscape to some extent, and the international Hilton Inns often are built along standard architectural lines. The result minimizes urban regional, national differences that formerly required some adaptive effort.

René Dubos once said (8-9) that the danger is not that we will be unable to adjust to our new environment but that we may adjust too well. He pointed out that man's adaptibility makes it possible to condition himself, which threatens to destroy the values which are characteristically human. That is to say, in terms of this dissertation, that man is capable of atrophy of his historical and conservative sense of nature if he over-stresses the function. And the danger is that for our working life most of us are much closer to and dependent upon the built up world than the physical world of nature. We spend time in offices, factories, institutions, communities or cities; these are our whole environment and they are theoretically <u>wholly</u> functional--as interpreted by society.

We are primarily concerned then with the problem of designing and building an environment that is both functional and wholly humanly satisfying. We should therefore be trying to identify and give as much attention to the historical and conservative qualities of the environment which are interwoven in our daily lives. Even the functional use of plastic and simulated wood, metal, leather, cloth, and plants can set up stress in our system, create suspicion, and when established as being artificial frustrate our historical sensory system. The use of 'make-believes' which are inconsistent with what we historically or instinctively feel the environment ought to be, creates tension in many persons. This tension is sometimes expressed in action.

The upsurge of the conservation movement expresses concern for the waste of the land and its resources. One of its most influential spokesman was Aldo Leopold whose work at the University of Wisconsin, and on his own farm, emphasized the interdependence of the geographical and the biological worlds. Nature was not simply the wonders of Grand Canyon or the immense forests of the northwest; it included the prairies, farm lands, brooks, rolling hills, and hedgerows quilting the countryside, that had been largely neglected by conservationists. To this landscape Leopold added the roles that were played by every living creature. His great contribution was to make Western men aware of nature in its infinite ecological detail (8-47).

The idealized Eastern man has been depicted as closer to nature in the sense that he has perceived himself as part of the organic whole that Leopold emphasized. How we perceive this environment is a product of our active interaction with it. How we behave in a setting is a function of how we see it. And Western man has assured scientific distance from his environment. But the impact of the environment frequently operates below the level of scientific awareness; often it is only when the environment is changed that we become aware of it. Further, different people may perceive the same environment differently depending on the environment where each grew up and on the values inherent in one's current living group. The environment does emit for most people a steady flow, and a great assortment of information that is transmitted through the senses simultaneously. Thus, man's perception of his environment is largely a product of his own past experience; he is the creation of that flow of signals and at any one time his experience of the esthetic quality of an environment reflects the complex interrelationship between the perceiver and the situation of which he is a part. It will naturally vary from one individual to another, from time to time, and from culture to culture. But the one common element in the perception of all environments is a degree of esthetic awareness. Thus Western man differs from the Oriental ideal only in degree, not in kind.

Annie Dillard in her book Pilgrim at Tinker Creek describes how nature will hide beauty from us because we simply don't see. But "the lover can see and the knowledgeable." In the same chapter she describes the experiences of people who had been blind and are helped through operations to see. For some it is suddenly too much and they would like to go back to blindness. For others, seeing becomes a gift. A twenty-two year old girl was dazzled by the world's brightness and kept her eyes shut for two weeks. When at the end of that time she opened her eyes again, she did not recognize any objects, but "the more she now directed her gaze upon everything about her, the more it could be seen how an expression of gratification and astonishment overspread her features; she repeatedly exclaimed; 'Oh God! How beautiful!'" (9-29).

None of us would want to have to learn to see by means of an eye operation. For some of us "seeing" is learned in play, perhaps due to growing up in a pleasant environment. Jens Jensen in his book Siftings writes:

> Down a shady lane wanders a little boy, his barefooted feet sinking deep into the warm dust as he trudges along his way, then out into a sunlit meadow. He wanders where daisies and butterflies nod and flit as he passes them by. Finally coming upon his favorite haunt, under over-arching branches he throws himself upon the cool moist earth and dreams of days to come and of marvels yet to be learned. (20-123)

By daily association this boy is coming into his inheritance. The voice of the land is making for him a warm heart and a strong faith in love as the beginning of all understanding (20-123).

The farm child obviously does not experience the same environment as the city child; each acquires a distinct place identity and a sense of belonging to a certain kind of locality on the basis of what the land or city-scape communicates. And that environment has been made for him by the perceptions of his elders.

David Demsey writes in An Introduction to Environmental Psychology:

> The environment is the product, not the cause, of perception. Perceiving in this sense is carried on by an individual from his own position in space and time and in terms of his own combination of past experiences and needs. It is just this way that transactionalists define perception: the process by which a particular person, from his particular behavioral center, attributes significance to his immediate environmental situation. In fact only when we order our world with ourselves

as part of the ordering transaction, only when our dealings with it are done with a purpose, and only as we relate the environment to our purposes is it truly perceived. (8-105)

Until we understand what people actually see in the sense of it registering in their minds when they respond to their environment, it will be difficult to understand how they act with respect to it. We need to know how people view various aspects of the natural environment--what they see when they enter this environment and how they respond to it. It is only when we understand what and how they perceive that we will begin to understand how they will act with respect to it. Demsey writes:

> Environmental psychology studies the role of perception which we view as a crucial element in the man-environment interchange.
>
> This is to say that each individual experiences the world about him in individual and unique ways. As part of this process the role of cognition is important--how we make sense of the inchoate environment around us.
>
> In this connection we are interested in stimuli that affect perception; in the spatial properties of the environment that influences patterns of behavior; in "real world" contingencies to which man must fashion a congruent relationship; and in the social relationships that are facilitated in his use of space. The environment is growth and development, and its role in learning is considered. (8-6)

To understand all these processes it is crucial that we have a knowledge of the values, attitudes, and the social and cultural norms which man brings to his environment. One way of achieving the knowledge is to discuss the "soul" of landscape as Jens Jensen does:

> It is quite essential to understand the soul of our own environment and of our own country before we can appreciate and understand the arts and intellectual efforts of other people and the forces that lie behind them. (20-18)

But it is not necessary to use such abstract terms. Jensen also stresses information before revelation:

> Knowledge and understanding of the out of doors reveal to one's mind motives and forms. These motives and forms are nothing to be copied, nothing to imitate, but they serve as an inspiration to sleeping forces that eventually will bear wholesome fruit. Art grows out of native soil and enriches life as a people attempt to express and develop this growth. It is contemporary to life itself and is fastened in the chain of human endeavor. It comes from within, stimulated by environments and influenced by the customs and habits of people. (20-18)

If we accept Jensen's statement then it would also mean that when reversed, the arts can be used to help us to see what the environment--the landscape--has been like through different periods of time. They provide information. This is a strong argument for studying the arts, the literature, and poetry relating to the landscape of an area, and, of course, drawings, etchings, paintings, and photographs. These arts can help us see by revealing glimpses of how others interpreted what the landscape of an environment has been, and by doing so, can guide us in restoring our own appreciation and understanding of a natural or even a cultural or humanized landscape.

But it is not the arts that Jensen has in mind:

> Art must be a guide, a leader, in the evolution of mankind toward a higher spiritual goal. None of the arts is more able to do this than that of a garden [garden in its broad sense--he does not mean the vegetable garden]. It is a living expression of peace and happiness and therefore a great influence in the forming of people. (20-95)

Man is not a passive product of his environment, he is its gardener, a goal-directed being, who acts upon his environment and who in turn is influenced by it. The chief influence is his perception and his perception of himself as gardener precipitates his actions. Recent research substantiates the premise of this thesis that understanding perception is the key to changing man's action on the environment.

> Viewers rated certain landscape features as colorful, beautiful, natural, and primitive at one extreme, and drab, ugly, artificial, and civilized at the other. These were seen as passive qualities involving "natural scenic beauty" and accounted for approximately sixty-two percent of the total variation among scenes. This is not an unexpected response since we usually think of a landscape in terms of its visual appeal.
>
> Less predictable was the finding that observers also perceive an underlying, dynamic quality in landscape features. This 'natural force' factor accounted for an additional twenty-four percent of the variance between scenes which were judged as either turbulent, rugged, and complex or tranquil, hushed, delicate, and simple. Auditory, olfactory and tactile sensations are seldom taken into account, yet the wilderness experience is a pleasant mixture; often an ephemeral one, of sounds, smells and touch as well as sight. (8-327)

These are the signals referred to earlier and they combine together in a perception of some kind of unity. Unity in the field of esthetics is called beauty. Beauty is thus a term for complete unity of organization; ugliness is lack of unity. According to Jens Jensen, if a thing has beauty, but falls short of being absolutely beautiful, it can be shown that such beauty as it has, is beauty of certain parts or aspects which are in themselves perfectly unified (18-20).

> As the unity of an object becomes more and more evident, the ease and completeness of the synthesis arising from unity of impressions and consonance of these with the mental content becomes greater, and the consequent pleasurable emotions become stronger. Thus a beautiful object, that is, an object so organized as to cause a complete synthesis in the observer's mind, should be perceived with the greatest possible amount of this kind of pleasure. And as the act of perception is in itself commonly unconscious, it is the pleasurable emotion which attracts our attention as the essence of beauty. (18-20)

It was stated earlier that the one common element in the perception of environment is a degree of esthetic awareness--i.e. of beauty or unity. Variety of awareness occurs because the standards for each observer come from his or her own experiences of the world, depending on one's culture or historical perception. But in changing his world man changes himself. Demsey calls this the dynamic interchange between man and his milieu. The traditional conception of a fixed environment to which organisms must adapt or perish is replaced by the ecological view that emphasizes the organism's role in creating his own environment--or of "gardening" it. And it is the equal variety of and change in the environment, the natural world, that gives significance to one's contact with it. The challenge of the landscaper is to guide man's modification of the landscape so that he may get the greatest possible esthetic satisfaction or sense of beauty. The real beauty of landscape is its obedience not to the laws of esthetic unity but to those of human nature--the harmony or unity of the historical, functional, and conservative perceptions by man of his landscape. The term for this unity is "the garden"--with its historical past, functional present, and conservative future all resting together at any one changing moment in harmony.

It is when we understand the structuring of the "garden" that we are able to "garden" our world in a recognizable and manageable way. To understand the structure of our environment we must first look at our sciences. The sciences of geology, pedology, climatology, botany, and anthropology can help us to restore, recreate or create ecologically sound landscapes which will give a feeling of belonging to man and provide him with esthetic pleasure as it has been defined in this chapter. There are many questions to be answered.

> What therefore is the role of the environment in providing us with a sense of future or, for that matter a past? Do we want order in our world? Ambiguity? Novelty? What is the appropriate environment that many biologists believe every organism seeks? Not necessarily a comfortable one, for a countless number of the worlds people live under conditions of physical discomfort and they do so quite willingly. This is not always a matter of economic necessity; a ravaged seacoast helps the inhabitants of such places find a sense of self-worth in their environment and in so doing satisfy one of the deepest psychological needs of men. (8-7)

In chapters II and III we will begin answering these questions by attempting to understand the workings of the existing landscape of the Great Plains through studying the natural and human sciences which can unravel for us their historic development.

CHAPTER II

THE FORMATION OF THE NATURAL LANDSCAPE OF THE GREAT PLAINS

Introduction

When we study the landscape we very quickly realize that the many various forms on the earth's surface--cities, rivers, mountain ranges, towns, forests, fields, rangeland, orchards, etc.--are all related to one another, more frequently so in the denser populated regions. Their variety and relationships make it difficult to understand the landscape as a whole or comprehensively.

In order more easily to realize the complexity of a landscape as a whole, we must begin with the basics of geology, for a specific geologic formation of the earth's crust is the basis of our landscape. The geological history of the land tells us first if our landscape resulted from a river delta, a mountain range, an old river bed, or is the result of ice age scouring and depositions, or other forces.

The geological form of the earth's crust is influenced by two main natural forces: climate (including water) and orogeny, i.e., mountain forming or volcanic action. But the landscape is not formed only by geological forces. Two other factors which give the landscape its character are the vegetative and the human element, and also with the latter the effects of animal behavior, either wild or domesticated; all these are dependent on climate, but whereas generally the geological influences are much slower than those of the climate, the most rapid influence of all is that of men. Climatic influences are discussed later in this chapter and those of man in chapter III.

Curiously, just before the influence of man on the landscape of the Great Plains began to increase with the beginning of European settlement, the science of geology became popular in the Eastern United States and in Europe. Paul Sheppard writes:

> A revolution in geology was occurring at about the time it became fashionable for large numbers of Americans to tour in the eastern (1830) United States. James Huttons' Theory of the Earth opposed biblical cosmogonies and catalysmic origins of landscape features, proposing instead that such formative processes as fossilization and stratification were continuous, that one needed only to go out and look. The idea that momentous processes that shaped the earth surface could be seen, on however small a scale, was a rather new idea. (38-131)

Thus both our understanding of geology, the basic science necessary to our understanding of the landscape of the Great Plains, and our occupation of those Plains begin at the same moment in history, and, moreover, it was that occupation which produced the new branch of geology, geomorphology. The concepts of geomorphology are the basis for understanding the landscape of the Great Plains.

Geomorphological Concepts

Although "geology" had been used as far back as the fourteenth century to describe "the science of earthly things," it was not established as a recognized science until the early nineteenth century. By the last quarter of that century geomorphology had been established as a branch of geology. William D. Thornbury in his Principles of Geomorphology (1954) defines geomorphology as the science of landforms. He mentions that Worcester (1939) defined geomorphology as the description and interpretation of the earth's relief features (44-1). This branch of geology is indebted to the West for its initiation.

The period between 1875 and 1900 has been referred to as the "heroic age of geomorphology." During this quarter century most of the concepts in this branch of geology evolved, the result of the field work of a group of geologists who performed the geological surveys of the western United States initiated after the Civil War. Thornbury gives credit to Major Powell, the one-armed Civil War veteran and first conqueror of the treacherous rapids of the Colorado River Canyon, for laying the foundation of the American school of geomorphology (44-9).

Powell was impressed by the importance of geologic structure as a basis for classification of land forms, and because that classification is basic to landscape theory, Powell may be said to be the founder of the American school of landscape theory. Powell devoted much attention to the results of stream erosion and proposed two classifications of stream valleys: one based upon the relationships between valleys and the strata which they cross; and the second a classification of valleys according to their origin. According to Thornbury probably the most widely applied of Powell's generalizations is his concept of a limiting level of land reduction, which he called base level. Powell recognized that the processes of erosion operating undisturbed upon the land would eventually reduce it to a lowland little above sea level. The name <u>peneplain</u> was later given to such an area by Davis (44-10).

Basic Concepts: Thornbury, following Powell, establishes nine basic concepts of geomorphology; these are not the only ones used in landscape interpretation, but they are the most useful in understanding landscapes (44-16):

I. The same physical processes and laws that operate today operated throughout geological time, although not necessarily always with the same intensity as now.

II. Geologic structure is a dominant control factor in the evolution of land forms and is reflected in them.

III. Geomorphic processes leave their distinctive imprint upon land forms, and each geomorphic process develops its own characteristic assemblage of land forms.

IV. As the different erosional agencies act upon the earth's surface there is produced a sequence of land forms having distinctive characteristics at the successive stages of their development.

V. Complexity of geomorphic evolution is more common than simplicity. Thornbury defines a resurrected landscape:

> [One] that was formed during some past period of geologic time, then buried beneath some sort of cover and then within more recent geologic time exposed through removal of the cover. Topographic features now being exhumed may date back as far as the Pre-Cambrians or they may be as recent as the Pleistocene. (44-25)

VI. Little of the earth's topography is older than Tertiary and most of it is no older than Pleistocene.

VII. Proper interpretation of present-day landscapes is impossible without a full appreciation of the manifold influences of the geologic and climatic changes during the Pleistocene period.

VIII. An appreciation of world climates is necessary to a proper understanding of the varying importance of the different geomorphic processes.

IX. Geomorphology, although concerned primarily with present day landscapes, attains its maximum usefulness by historical extension.

Geomorphic Processes: In Thornbury's outline of the geomorphic processes the most useful for understanding the landscape of the Great Plains are those classified as "gradation" (44-34):

Gradation in the form of degradation through weathering and mass wasting or gravitative transfer; erosion (including transportation) by running water, ground water, waves, currents, wind, and earlier tides and glaciers; aggradation by running water, ground water, waves, currents, wind and in the past tides and glaciers; work of organisms, including man.

The term gradation is used by Thornbury to mean "all those processes which tend to bring the surface of the lithosphere to a common level." Those which level down are called degradation and those which level up aggradation (44-35).

In these processes the most important force is that of climate, according to Thornbury:

> If it is recognized that different geomorphic processes produce different landforms, it follows that the characteristics of the topography should to a certain degree reflect the climatic conditions under which the topography developed. . . . Geographers more than geologists are likely to recognize the significance of the similarity in the world distribution patterns of physiographic regions, soil groups, vegetation types, and climatic regions. The common dominator which helps to explain these similarities is climate. (44-63)

Morphogenetic Regions

Recognition of the primacy of climatic forces gives geomorphologists the concept of morphogenetic regions:

> Under a certain set of climatic conditions particular geomorphic processes will predominate and hence will give to the landscape of the region characteristics that will set it off from those of other areas developed under different climatic conditions. (43-63)

According to Thornbury, Peltier (1950) has made a tentative list of morphogenetic regions. A different approach is taken by Robert Ruhe in his book Quarternary Landscape in Iowa (1969); he refers to the landscape as that portion of the land surface that the eye can comprehend in a single view. More specifically he makes landscape a collection of landforms:

> Landforms are the features of the earth that together make up the land surface. They may be large features such as plain, plateau, and mountains, but may also be small features such as hill, valley, slope and the like. Most landforms are products of erosion, but some of them are formed by deposition of sediments, by volcanic activity, or by movement within the crust of the earth. (33-5)

But Ruhe further states that if formality is required then geomorphic surface may be used and a landscape is then defined as a portion of the land surface that is specifically defined in space and time (33-5).*

According to Ruhe the geomorphic surface must be a mappable feature. Its geographic limits and distribution in elevation must be

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*Ruhe describes the spectacular event of volcanic activity and the change of well known and well recorded landscape near Kapaho Village of Hawaii, which due to volcanic action changed into a new landscape. As he writes, "there is no question about when was the construction of this landscape. It formed during January and February, 1960" (33-7).

delineable on aerial photographs or topographic maps. This makes it a very integral part of modern day regional landscaping where such aids are extensively used. A good example is the work of Ian McHarg.

Ruhe further states that a geomorphic surface has geometric dimension which must be specified and which may be analyzed; it must be defined in association with other geomorphic surfaces in order to place it properly in its spatial and time sequence; for example, it may be associated with bedrock or sediments and may have bedrock or sediments associated with it. These associations must also be specifically defined in space and time. After definition of all the above relationships, the geomorphic surface is labeled and is usually given a geographic name (33-5). The common name of the geomorphic region which is the subject of this study is "The Great Plains" but we need to know its nature more scientifically in order to understand its landscape.

Development During Holocene

The Appalachian mountains, a major landscape form along the east of the United States, were formed 280 million years ago during the period of the lower Permian, in the late Paleozoic era. Today we know the Appalachians as a scenic area of extreme beauty. At the same time it is an area known for its socio-economic difficulties. But if we concentrate on the origin of the landform we also know that approximately 280 million years have elapsed since its emergence, and that erosion has given us the landform as we know it today. Just as that landform is different from that of the Great Plains--a difference visible to everyone--so the geologic history of the Great Plains differs from that of the Appalachians.

For instance, the lawn around the courthouse at Smith Center, Smith County, Kansas is raised 14 inches above the cement sidewalk; it is the result of recently blowing soils. Here is a change in landform of admittedly minor scale yet obviously the result of active and recent erosion forces; according to the local inhabitants, the top four inches of soil had been added to that lawn's height only in the last fifteen years. Such aggradation could not occur in Appalachia as a result of climatic forces. This phenomenon is a sign of the nature of morphological forces at work in the morphogenetic region of the Great Plains.

The larger the landform the further one would have to go back through earlier geologic periods, but in understanding the landscape of the Great Plains, it is sufficient to concentrate on the more recent Holocene epoch.

Geologically, plains are usually the result of the deposition of fine materials by water. Often sediment has been laid down on the bottom of a former sea or lake resulting in horizontal strata; the minor variations of the surface landscape are basically the natural results of variations in the depositional currents of water and in the character of materials deposited. Subsequent erosion alters the landform with cuts and broad valleys which remove the surface water and permits us to study the horizontal data.

Plains are almost never perfectly level, and without losing their essential flatness it is quite possible for plains to have noticeable minor undulations. These undulations under various effects of light and shadow do give a unique landform pattern. Enhanced through this color variation, it provides endless variety to those who can see the formations in both the horizontal strata and the surface at the same time. This double focus depends first on an appreciation of the geology of the Great Plains in the Holocene epoch.

Geological Regions: The Quartenary Period of geologic time encompasses the last ice age, the Pleistocene epoch and, subsequently, the Holocene or Recent epoch. The Quartenary time saw the evolution of modern man and the development of human cultures. The geology of the quartenary epoch in the Great Plains divided this area into three regions: the Northern Great Plains, comprising South Dakota, North Dakota and part of Montana that is east of the Rocky Mountains; the Mid-Great Plains, comprising Nebraska and northern Kansas; and the Southern Great Plains, comprising Central Kansas, the eastern edge of Colorado and southward to the area in southwestern Texas where the High Plains run into the Edwards Plateau.

The Northern Great Plains have been under influence of the continental glaciers. The preglacial land surface was more dissected and relief was greater than that of the present drift surface.

Most of the drift surface of the Northern Great Plains is gently rolling and slopes eastward from an altitude of about 1200 meters in Montana to approximately 300 meters in eastern North and South Dakota. Drainage is into the Gulf of Mexico by the Missouri River, its tributaries, and the Mississippi River. Stream valleys, together with a few mountain outlines and moraine hills and ridges, break monotonous expanses of subdued topography. Much of the Missouri River valley is two to three kilometers wide and has steep, locally dissected bedrock walls from 100 to more than 200 meters high.

The most eastern subdivision of the Great Plains province is a topographically high belt of hummocky, dead-ice morainal material and includes end moraines of several different ice advances. This area is called Côteau du Missouri. It is 30-120 kilometers wide and extends from northeastern Montana to south central South Dakota. It attains a maximum altitude of approximately 750 meters in northwestern North Dakota.

Several mountain outliers and other high areas are drift free in the otherwise glaciated portion of Montana. Some of these are the Sweetgrass Hills, Bearpaw, Highwood and little Rocky Mountains and the Flaxville Plain. Proglacial lakes in the northern Great Plains formed in north running valleys when drainage was blocked by advancing glaciers (48-15,18).

In North Dakota the Central Lowland surface slopes northeastward from an altitude of about 570 meters near the Côteau du Missouri to about 240 meters on the floor of Glacial Lake Agassiz in the northeast corner of the state.

The Turtle Mountains which rise 90-120 meters above the surrounding terrain are a mesa-like plateau of Tertiary bedrock capped by dead ice morainal material. Thick deposits of ground moraine, outwash deposits, well-defined end moraines, and glacial-like deposits cover most of the central lowland in North Dakota. Bedrock outcrops are mostly confined to small exposures along stream valleys.

Three glacial lakes covered part of the central lowland area of North Dakota. Of these the Glacial Lake Agassiz was the most extensive. The area covered by this lake is a remarkably flat plain. The lake floor is 50-75 kilometers wide. The lacustrine deposits, which consist of silt, sand and, in places, bedded clays, range in thickness from a few meters to more than 20 meters.

Glacial Lake Souris was a proglacial lake that enlarged northward as the ice front receded. Its bed is very flat, local relief generally being less than 3 meters. The deposits range in thickness from zero to 22 meters and consist chiefly of sand, with lesser quantities of fine gravel, silt and clay. Deposits of Glacial Devils Lake are thin and patchy in most places; boulders and cobbles, derived from reworking of till by wave action, are scattered over the former lake floor (48-18).

The Central Lowland in South Dakota extends over the eastern third of the state. The most conspicuous feature is a widespread, high land area reaching altitudes of over 630 meters, called Côteau des Prairies. It extends south eastward from the North Dakota border into Minnesota and northwest Iowa. Its height of 180-240 meters is mainly due to a thick accumulation of glacial drift rather than to bedrock.

The broad James River lowland lies mostly at altitudes ranging from 390 to 420 meters. The plain is generally 40-50 kilometers wide with local relief occasionally exceeding 1 meter and rarely exceeding 3 meters. Lake sediments consist mostly of silt with some fine sand and clay. Their average thickness is about 12 meters, and maximum thickness about 30 meters (48-18).

The extreme northeast corner of South Dakota was occupied by the south end of Lake Agassiz, which was drained by a steep sided trench, mostly one to three kilometers wide and about 30 meters deep. This trench now contains Lake Traverse and Big Stone Lake. The ridge between these lakes forms the present Continental Divide between northward drainage into Hudson Bay via the Red River and southward drainage into the Gulf of Mexico via the Minnesota and Mississippi rivers (48-19).

Four glaciations have been recognized in the midwestern United States. In chronological order these are the Nebraskan, Kansan, Illinoian and Wisconsin. The Wisconsin glacial deposits predominated and six separate glacial advances during Wisconsin time are thought to have taken place in the area. Because all the drift deposited is very similar in appearance and lithology, and because only a few radiocarbon age dates are available, the correlation of these advances with the Pleistocene stratigraphic sequence of the midwestern United States is uncertain (48-27).

The topography in the area covered by these glacial advances has been little modified since deglaciation. Nearly all glacial features are well preserved, and there has been little or no down cutting by present day streams (48-24).

Sand dunes have formed on some of the glacial lake floors and outwash plains in North and South Dakota but it is thought that most of these formed soon after deglaciation (48-24).

Several mountainous areas and parts of the high plains in the glaciated area of Montana were too high to be covered by continental ice sheets. The areas beyond glaciation in the three states were the western corner of North Dakota, South Dakota and roughly the southern half of Montana. In the unglaciated area of South Dakota which is isolated with closely spaced hills, buttes rise to altitudes of more than 1080 meters. Nearly all the streams have cut canyons 60 meters or more in depth. Along the Cheyenne and White rivers extensive badland topography has developed.

Sand dunes derived from underlying sandy bedrock are common in the extreme south central part of South Dakota, where they form an undulating surface of low relief. Often springs flow from their northern margin (48-25).

In North Dakota the unglaciated upland is a continuation of the upland in South Dakota. Isolated erosion remnants with a maximum altitude of 1060 meters are part of the upland.

The gently rolling upland surface appears to be in a stage of late maturity. Drainage patterns are well developed, but at present there is relatively little surface runoff. This is because the area is situated in the semi-arid climatic region (48-25).

In this area also extensive badlands have formed in many places adjacent to the Missouri and Little Missouri Rivers. The upland is modified by a number of wide valleys running to the southeast, not all of which have streams. Those without streams were glacial melt-water diversion channels (48-25).

The unglaciated eastern part of Montana is much the same as the unglaciated parts of North Dakota and South Dakota. The Yellowstone River and its tributaries have cut trenches 1.5 to 6.5 kilometers wide and a few hundred meters deep. Periods of cutting and filling have produced several terraces.

The Mid-Great Plains elevations range from 230 meters in the southeast corner to more than 1340 meters in the west central part. The Missouri river forms the eastern boundary of the area. The northeastern part has also been glaciated during parts of the four major ages of continental glaciation.

The drainage pattern of eastern Nebraska and northeastern Kansas is generally developed on loess-mantled Pleistocene till. Many of the present drainage patterns began to develop in middle to late Kansas time, and some drainage divides have been recognized as loess-mantled moraines (48-190). The first advance of the Kansan ice, resulting in the deposition of the Nickerson till was the most extensive. The moraine of the Nickerson till probably determined the drainage divide between the Big Blue and Little Blue River systems near the Kansas-Nebraska line. This moraine was later extensively eroded.

The second advance of Kansan ice resulted in the pronounced moraine that forms the divide between the Big Blue River system and drainage tributary to the present Missouri River above Kansas City. This divide forms an almost continuous landscape feature across the southern part of eastern Nebraska and northeastern Kansas; it is breached by the Platte River valley in Nebraska and by the Missouri River above Kansas City. The interior drainage that is tributary to the Missouri River above Kansas City shows many southeastward curving trends that appear to have been controlled by minor recessional moraines formed during the retreat of the second Kansan glaciation. Some broad south-southeast running valleys were formed in eastern Nebraska after the retreat of the second Kansan ice (48-194).

An area of more than 52,000 square kilometers of stabilized sand hills is an unusual feature of north central Nebraska, with smaller areas to the west and southwest. Occurrence of longitudinal dunes superimposed upon transverse dunes suggest two periods of dune formation. The dune sand deposits obliterated the earlier Pleistocene drainage pattern in the sand hills, resulting in the formation of many closed basins and water table lakes.

The Southern Great Plains is a region dominated by the relatively flat but eastward sloping surface of a plateau called the High Plains, but it also includes the dissected eastern and western margins of this plateau. The surface of the High Plains ranges from more than 1700 meters to less than 850 meters above sea level.

Strong local relief only occurs along the escarpment that marks the eastern and western limits of this area. East of the High Plains a belt of dissected topography, ranging from a wide zone called the Plains border in northern Kansas through the 13-40 kilometers wide strip of Red Hills in southern Kansas and the related topography in western Oklahoma and northern Texas, to a sharply defined, east-facing escarpment in central western Texas. In the areas where this zone of transitional topography is narrow it has been called the Break of the Plains (48-203).

Although the southern Great Plains region is externally drained, a significant part of the upland surface comprises undrained, shallow deposits which have been developed largely in late Tertiary and

Pleistocene deposits. They have complex origins including: differential filling of erosional valleys and of solution--collapse basins, differential compaction, silt infiltration in alluvial sediments, wind deflation, solution of caliche zones, and perhaps even animal action. In some areas of the High Plains surface, these shallow depressions are so numerous that the landscape is dotted with intermittent lakes after the infrequent rains (48-205).

Generally during the recent period (i.e. approximately the last 5,000 radiocarbon years), the landscape of the southern Great Plains has been characterized by brief, minor pulses of erosion alternating with minor episodes of alluvial deposition, and by eolian activity that has caused minor deflation, accumulation, and migration of dune sands. Since the appearance of extensive stock raising and agriculture, regional shallow deflation accompanied by highly localized deposition of fine sands and silts around both natural and artificial obstructions has occurred. During this time gully erosion has locally been accentuated and the intermittent pools of the minor valleys, previously retained by grass sod, have largely disappeared.

Soils of the Great Plains

Soil is the natural medium for the growth of land plants, whether or not it has "developed" soil horizons. Soil in this sense covers land as a continuum except on rock slopes, in regions of continuous cold, in very salty places, and where the cover of soil disappears. Soil has many forms. Its characteristics in any one place result from the combined influence of climate and living matter acting upon the parent rock material as conditioned by relief over periods of time, including the effects of the cultural environment and man's use of the soil.

Soils are landscapes as well as profiles, and they indicate morphogenetic regions. The soil mapper has always recognized this in drawing soil boundaries. Commonly they come at the foot of an escarpment, at the margin of the swamp forest, or at some other obvious boundary among natural landscapes. In the concept of soil as landscape, slope is an important soil characteristic. Soils, like other natural bodies, have shape--e.g. we talk about sloping soils (42-6).

In studying the characteristics of soil and in predicting its potentialities for use, we cannot work with the whole continuum at once. Individual kinds of soil must be recognized, but the first step to soil identification is the recognition of the natural forces which created and positioned them.

The soils of the Great Plains are mainly formed from sedimentary rocks. These include those rocks formed from the consolidation of sediments laid down in previous geologic ages. The principal broad groups of hard sedimentary rocks are limestone, sandstone, siltstone, shale and conglomerate. There are many varieties of these broad classes of sedimentary rocks, and many intermediate types between them, such as calcareous sandstone, arenaceous limestone, and so on. Many soils are developed from their weathering products and from those of interbedded sedimentary rocks; they are the result of three forces--water, wind and glaciers.

Natural Forces: An important group of parent materials in the Great Plains is made up of materials that have been moved from the place of their origin and redeposited during the weathering processes or during some phase of those processes and which consists of or are weathered from unconsolidated formations. The principal groups of these materials are usually named according to the main force responsible for their transport and redeposition:

Water movement: Alluvium is the most important of the materials moved and redeposited by water. It consists of sediments deposited by streams. Remnants of very old stream terraces may be found in dissected country, far from any present stream. Recent alluvium often covers older terraces.

Generally, the alluvium may be divided into two main groups according to origin: (1) Local alluvium, like that at the base of slopes and along small streams flowing out of tiny drainage basins of nearly homogenous rock and soil material, and (2) general alluvium of mixed origin, like that along major stream courses.

Colluvium is another material moved and redeposited by water. The distinction between alluvium and colluvium is somewhat difficult and arbitrary. Some authorities hold that colluvium is strictly the material moved primarily under the influence of gravity, only imperfectly sorted, if sorted at all; and they include under alluvium all materials moved primarily by water. Generally, however, colluvium is used for the poorly sorted materials near the base of strong slopes that have been moved by gravity, frost action, soil creep, and local wash.

Lacustrine deposits consist of materials that have settled out of the quiet water of lakes. Those laid down in fresh-water lakes associated with glacial action are commonly included as a subgroup under glacial drift. Besides these there are other lake deposits including those of Pleistocene times, unassociated with the continental glacier. Some old lake basins in the western part of the United States are commonly called playas and may be more or less salty, depending on the climate and drainage.

Marine sediments are sediments which have been reworked by the sea and later exposed either naturally, or through the construction of dikes and drainage canals. They vary widely in lithological and textural composition. Some resemble lacustrine deposits.

Beach deposits are low ridges of sorted material, often gravelly, cobbly, or stony. They mark the shore lines at old levels of the sea or lakes. Those formed on beaches of glacial lakes are usually included with glacial drift.

Wind movement: Some materials are removed and redeposited by wind. The wind-blown materials are generally divided into two classes, mainly in accordance with texture. Those that are mainly silty are called loess, and those that are primarily sand are called eolian sands, commonly but not always in dunes.

Typically, deposits of loess are very silty but contain significant amounts of clay and fine sands. Usually, but not always the material is calcareous. Most loess deposits are pale brown to brown, although gray and red colors are common. The thick deposits are generally massive, with some gross vertical cracking. The walls of road cuts in thick loess stand nearly vertical for years. Other silty deposits derived in other ways, however, have some or all of these characteristics. Then, too, some wind-blown silt has been leached and strongly weathered so that it is acid and rich in clay. On the other hand, young deposits of wind-blown silty very fine sand, called loess, are exceedingly low in clay.

Characteristically, sand dunes, especially in humid regions, consist of fine or medium sand that is very rich in quartz and low in clay-forming minerals. Yet nearly all transitions may be observed between the silty wind-blown materials called loess and the very sandy material in characteristic sand dunes. Especially in deserts and semideserts, the sand dunes may contain large amounts of calcium carbonate and clay forming minerals that would decompose to clay in a more humid environment. Examples may even be found of sand dunes, using sand in its purely textural sense, that consist almost wholly of calcium carbonate or of gypsum.

During periods of drought, and in deserts, local wind movements may pile up soil material of mixed texture or even materials very rich in clay. Piles of such material have been called "soil dunes" or "clay dunes." It is better to use the term "wind deposited materials" for such local accumulations of materials of mixed texture moved by the wind than to identify them as loess or dunes.

Glacial movement: There are several classes of materials moved and redeposited by glacial processes. The first is glacial drift which consists of all the material picked up, mixed, disintegrated, transported, and deposited through the action of glacial ice or of water resulting primarily from the melting of glaciers. In many places the glacial drift is covered with loess. Deep mantles of loess are usually easily recognized, but very thin mantles are so altered by soil-building forces as to be scarcely differentiated from modified drift.

Glacial till includes that part of glacial drift deposited directly by the ice with little or no transportation by water. It is generally an unstratified, unconsolidated, heterogeneous mixture of clay, silt, sand, gravel and sometimes boulders. Till may be found in ground moraines, terminal moraines, medial moraines, and later moraines. Drumlins are long cigar-shaped low hills of glacial till, with a smooth sky line and with their long axes lying parallel to the line of movement of the ice.

Glaciofluvial deposits are made up of materials produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. The most important of these is glacial outwash near moraines; poorly sorted outwash materials may exist in domes, eskers and crevasse-fills.

Glacial beach deposits consist of gravel and sand and mark the beach lines of former glacial lakes. Depending upon the character of the original drift, they may be sandy, gravelly, or cobbly.

Glaciolacustrine materials range from fine clays to sand. They are derived from glaciers and reworked and laid down in glacial lakes. Many of them are interbedded or laminated. Varves are the fine horizontal markings exposed in a section of glaciolacustrine clay, each related to one year's deposition and one season's glacial-ice melt.

Gravity Material: Materials are also moved and redeposited by gravity; colluvium is the unsorted or slightly sorted material at the base of slopes, accumulated largely as rock fragments that have fallen down the slope under the influence of gravity. In its extreme form this material is called talus. Rock fragments are angular in contrast to the rounded water worn cobbles and stones in alluvial terraces and glacial outwash.

Soil Regions: The Agricultural Yearbook, Soils (1957), divides and describes the Great Plains in three soil regions. They are the Northern Great Plains, the Winter Wheat Grazing region, and the Southern Plains.

The Northern Great Plains consists of approximately two-thirds of Montana, all of North Dakota and three-quarters of South Dakota and about half of Nebraska. In this region broad zones of soils correspond to broad differences in climate and vegetation. The Chernozem, Chestnut, and Brown soil zones are aligned in a generally north and south direction corresponding to climatic belts.

The eastern-most part has a dry-subhumid climate while the climate of the central and western part is characterized as semi-arid. The Chernozem soils, largely devoted to crops, occupy the most humid part. They have thick, black surface horizons and a large amount of organic matter. The Brown soils occur in the driest part and are devoted primarily to grazing. They have thin, brown surface horizons and relatively little organic matter. The Chestnut soils, between the Chernozem and Brown soils and intermediate in these features, have thin, black or dark-brown surface horizons and moderate organic matter.

The topography generally permits cultivation. Steeply sloping land occurs in the sandhills of Nebraska, the Black hills in South Dakota, the deeply dissected, high, old terraces in Montana, and the river breaks in all parts. Steep lands, and sandy or thin soils, usually are devoted to rangeland. Spring wheat is grown throughout the region if soil and topography are suitable over a large enough acreage. These factors and climate form a pattern that gives rise to production of spring wheat in the northeast and range livestock in the western and southwestern parts.

The sandhills section in northwestern Nebraska is an extensive area of windblown sands in rounded or choppy hills and irregular ridges and intervening draws and broad bottom lands. Large streams are few.

Wind erosion continues to be a serious problem in some localities and is a threat on most cultivated soils. Sandy soils are especially subject to wind erosion because they often contain too little silt and clay to form large aggregates resistant to wind action. Loams and clays more commonly have a fairly resistant structure. Repeated freezing and thawing, and wetting and drying, often cause structure to deteriorate because of the formation of aggregates of a size susceptible to wind action. Soils high in clay are most subject to this type of deterioration.

Shelter belts of trees, permanent or rotation seeding of grass, strip cropping, measures to preserve a protective cover of residue, timely tillage, and proper fertilization all have a place in a program to control wind erosion.

The Winter Wheat and Grazing region consists mainly of four-fifths of western Kansas, southwestern corner of Nebraska, eastern part of Colorado and northern part of Oklahoma and Texas. This region has an average annual rainfall which is more than 38 inches in the southeast and less than 14 inches along the western edge.

Considerable variation in temperature also occurs and with the wide variation of climate comes a variation in vegetation, but the vegetation over the whole region is different species of grasses. The result is a diversity of soils developed under this climate and native vegetation. The soils include the deep, dark prairie and reddish prairie soils in the central parts, and the shallower and lighter colored chestnut, reddish chestnut, and brown soils of the west. Scattered through these zonal soils are some shallow soils on bedrock, and some sandy soils and sand dunes.

The Southern Plains cover the central two-thirds of Oklahoma and central Texas to the Gulf of Mexico. The climate of this region is semi-arid to humid. Winters are extremely cold in places and mild elsewhere. The summers usually are hot.

The topography varies from nearly level to strongly rolling. Surface drainage is well developed except in the part of the region that is on the Southern High plains in Texas. The soils range from slightly acid to calcareous,and from deep sands and clays to thin soils. Much of the area is range land.

The information on soils was taken from Agriculture Yearbook Soils 1957 (29-494-523). More information on soils of the Great Plains is taken from the Agriculture Yearbook Soils and Men 1938 (41-1075-1080-1085).

Soils of the Chernozem groups are developed in temperate subhumid grasslands. The surface soils are very dark brown to black. The underlying material varies greatly as a result of the influence of parent material, but a distinguishing feature of these soils is an accumulation of carbonates, principally lime carbonate in the lower part of the solum. The Chernozem soils are developed in a broad belt in the central part of the United States on the tall-grass plains, mainly where the precipitation ranges from 18 to 28 inches.

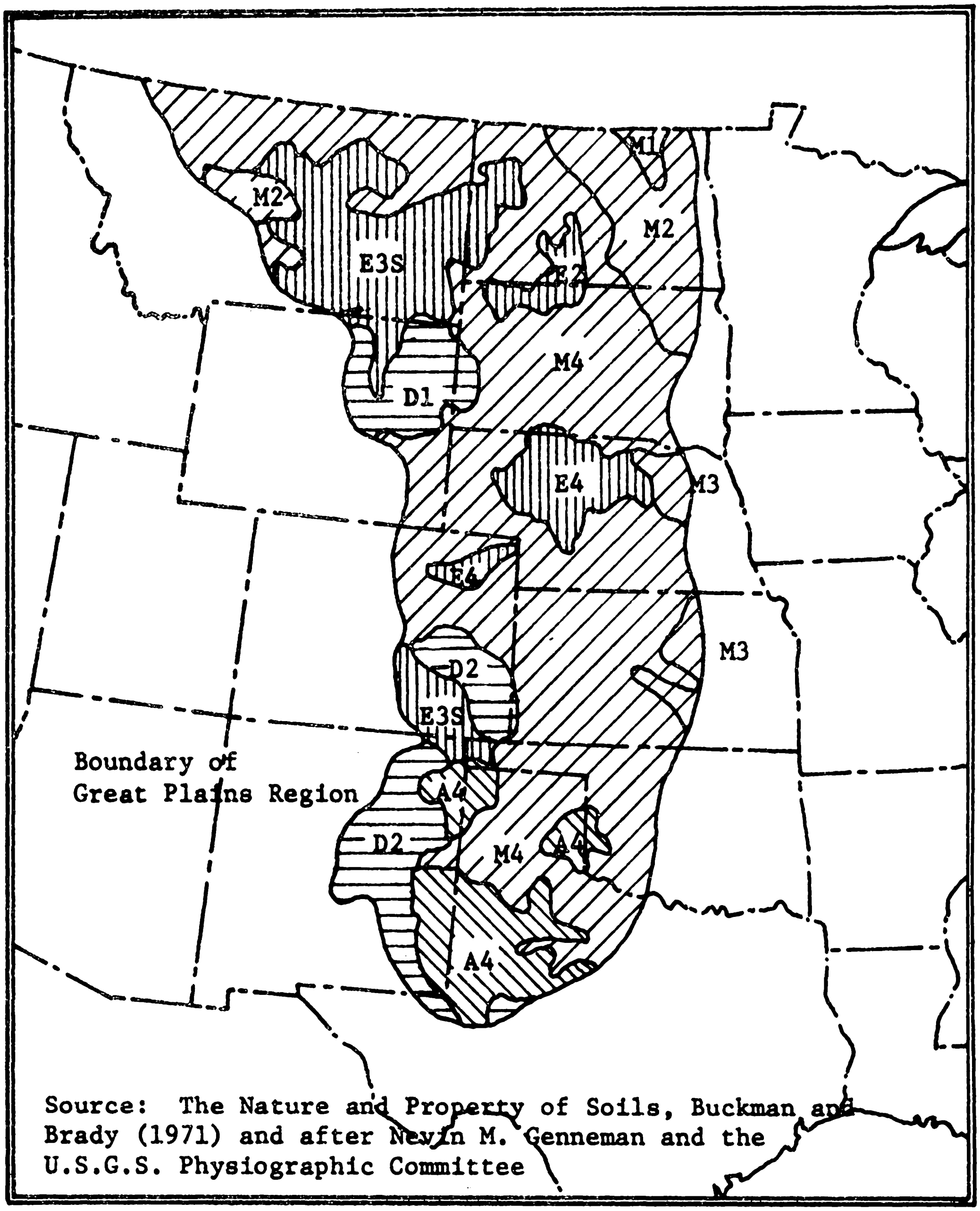
Chestnut soils as developed on the Great Plains, are characterized by dark brown or dark grayish-brown surface soils grading into light-gray or white calcareous horizons at a depth of 1 1/2 to 2 feet. These soils are found west of the Chernozem belt and develop in temperate to cool semi-arid regions under a mixed short- and tall-grass vegetation.

The reddish chestnut soils which develop on the grassy plains from southern Kansas south through Oklahoma and Texas are typically dark brown to red in the upper part and lighter or grayer in color and highly calcareous in the lower part. These soils have relatively high inherent fertility, but the low rainfall and high rate of evaporation tend to limit crop growth.

The chernozem soils are developed in temperate subhumid regions under tall grass vegetation. The grasses are heavy feeders on bases and return them to the soil surface fast enough to prevent the soil from becoming acid under the comparatively low rainfall. Large amounts of humus accumulate and the soils are nearly black in color for 1 to 3 feet in depth. Since there is little movement of insoluble material, except as surface soil material falls into cracks, there is little difference in clay content between the different layers of the soil profile. In the Chernozem the soil particles are grouped into granular or crumb-like aggregates and provide an excellent structure for crop plants. There is sufficient leaching to remove the most soluble salts but not enough to remove the calcium and magnesium carbonates completely. These accumulate in the lower part of the true soil, or just beneath it, in what is called a lime zone or carbonate horizon. Beneath this horizon there is frequently a layer of accumulations of the slightly more soluble calcium sulfate or gypsum. All of the zonal soils of the semi-arid regions have such a layer of carbonate accumulation. One of the most significant differences between the Chernozem soils of eastern North Dakota, South Dakota, and Nebraska and the Prairie soils of Iowa and Illinois is that the Prairie soils have no horizon of accumulated carbonates (21-279).

The new comprehensive soil classification system divides the soils of the Great Plains in patterns of soil orders and suborders. Only the dominant orders and suborders are shown on the map (Fig. 1). Each delineation has many inclusions of other kinds of soils which will be shown later when looking at the soil of Kansas.

The majority of the soils of the Great Plains belong to the soil order of Mollisols 'M'. These are soils with nearly black organic-rich surface horizons and high base supply. Suborders of the Mollisols on the Great Plains are Ustols 'M4' and Aquolls 'M1'. Ustols are soils



A4	Ustalfs	M1	Aquolls
D1	Argids	M2	Borolls
D2	Orthids	M3	Udolls
E2	Orthents	M4	Ustolls
E3S	Orthents (steep)		
E4	Psamments		

Fig. 1. The Great Plains; patterns of soil orders and suborders.

which are dry for long periods during summer, they are gently to moderately sloping and are used for growing wheat and as range in the western part. In the eastern part they are used for wheat and corn or sorghum. Aquolls are soils which are seasonally saturated with water. They are gently sloping and are mostly drained and farmed (42-312).

Other soil orders are Entisols 'E' and Alfisols 'A'. The Entisols, soils without pedogenic horizons, are further divided in suborders of Psamments 'E4'. They are sandy or loamy textured sandy soils which are gently to moderately sloping and are mostly used for range; Orthents 'E3S' which are shallow soils to hard rock and are mostly used for range. Also Orthents 'E2' which are soils with loamy or clayey textures on deep to hard rock; gently to moderately sloping. This land is used for range or irrigated farming (42-312).

The Alfisols are soils with gray to brown surface horizons, medium to high base supply, and subsurface horizons of clay accumulation. They are usually moist but may be dry during a warm season. The suborder is the Ustalf's (A4). These soils are warm and intermittently dry for long periods. They are gently to moderately sloping. They are used for range, small grain and irrigated crops (42-312).

Soil development is greatly influenced by climate with which we are concerned next.

Climate of the Great Plains

In much of the literature devoting itself to settlement of the Great Plains the extremes of the climate are repeatedly brought out.

The 1941 Agriculture Yearbook Climate and Man gives a good insight into the climate of the Great Plains. Warren Thornhwaite in his chapter on "Climate and Settlement in the Great Plains" stresses the importance of understanding the climate on its own terms and not on those of preconceptions:

> In a desert, you know what to expect of the climate and you plan accordingly. The same is true of the humid regions. Men have been badly fooled by the semi-arid regions because they are sometimes humid, sometimes desert, and sometimes a cross between the two. Yet it is possible to make allowances for this too, once the climate is understood. (21-177)

The most important characteristic of the climate is its variability.

Rainfall: The Great Plains comprise the largest uninterrupted area with semi-arid climate in North America. This means that the rainfall is both variable and scanty. It averages less than 20 inches annually except in the warmer southern region, and only slightly more than 10 inches in the north; the driest year can bring less than 10 inches and the rainiest more than three times as much.

The path followed by the tropical maritime air, that is the air originating over the Gulf of Mexico and the Atlantic between Bermuda and the Bahamas, characteristically curves across the Gulf up the Mississippi Valley, and then eastward to the Atlantic. It tends to avoid the Great Plains. The tropical air masses which do flow northward across the Great Plains come generally from the dry plateau of Mexico and are warm but contain little vapor. When this air comes in contact with the cold heavy air from the polar continental airmasses it is forced up but normally little precipitation results from the consequent cooling.

The moist air from the Gulf does not always avoid the Great Plains and the result is that some rain does fall. The farther the tropical air has traveled from its source of moisture the drier it becomes and the less will be the precipitation that results from its cooling. There is a gradual decrease in average annual precipitation from approximately 25 inches in South Texas to less than 12 inches in northern Montana.

Under abnormal conditions violent rainstorms and heavy precipitation occur because masses of very moist tropical air enter the Plains region and collide with dry polar air. Such a storm may bring as much as a third of the average annual rainfall in a single day, or even a fifth in a single hour. On the other hand, periods as long as 120 days may occur during which no rain falls.

Temperatures, Etc.: The interaction of tropical and polar air masses causes the excessively high and low temperatures of the Plains. The displacement of warm tropical air by an advancing mass of cold polar air can cause a drop in surface temperature of as much as 60°F in a few hours. Maximum summer temperature in excess of 110°F have been experienced nearly everywhere in the Plains, and records of 117° have been reported from both Texas and Montana. Below-zero temperatures have occurred throughout the region but the minimum becomes lower as the latitude increases and reaches a record of -63° at Poplar in Montana. In 1893 at Glendive, Montana, the absolute minimum was -47° for February and the absolute maximum was 117° for July, a range of 164°F (21-79).

Other climatic hazards of the Plains are hail, frost and hot winds. These extremes are also caused by the moving in and meeting together of the various types of air masses. The hailstorms which are most common during the summer are the results of vigorous upward displacement of warm air along the advancing front of a cold air mass.* In spring and autumn an advance of polar air may cause killing frost. Equally serious is the hazard presented by the hot dry winds of summer that are at times experienced in all parts of the Plains.

Drought: The periods of drought on the Great Plains are greatest in winter and least in late spring and early summer. Drought periods of 35 or more consecutive days may be expected annually and periods of between 60 and 70 days once in 10 years. Less frequently, a drought period may reach 90 days in the northern Great Plains, and 120 days in the southern Great Plains.

The drought hazards in autumn and winter are approximately equal in the central and northern Plains, but in the southern Plains the winter drought hazard greatly exceeds that of any other season. Throughout the Plains prolonged periods of drought are least likely to occur in summer.

Weaver writes about the death of trees during the great drought, how several years of decreasing precipitation initiated the seven years of drought. The twelve month period following June 1933 was the

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*The world's biggest authenticized hailstone fell at Potten, Nebraska on July 6, 1920. It was 1 1/2 pounds in weight and measured 5 1/3 inches in diameter (Farm Journal, July, 1964).

driest weather ever recorded in several midwestern states. This intensely dry period, as well as those in several of the following years, was accompanied by record-breaking temperatures, extremely low humidities, and exceptionally high rates of evaporation. During the same period high winds, swarms of grasshoppers and great duststorms also prevailed (47-140).

The dustbowl of the '30's illustrates most vividly the effect of the variability of the climate with the resulting movement of soil. Forgetting for a moment that men broke the prairie sod and opened up the soil it was the lack of rain which dried out the soil and caused plants, shrubs and trees to die. When plant material could no longer protect the soil from strong winds, the soil blew away. The fact that plant material died all over the Great Plains in the thirties illustrates the importance of landscape conservation.

Plant Ecology and Plant Geography of the Great Plains

The name "Prairie" was given to grasslands of the Midwest by the early explorers. It is the French word for a large expanse of grass. In my readings I never came across an Indian name given to this vast treeless region, other than the State name Kansas derived from an Indian word, meaning "land of the south wind." The Indians played a part in the ecology of the grasslands by setting the grass afire to stimulate new grass growth in spring or to drive the buffalo, or sometimes to help in their escape from pursuers. They lacked the numbers and the need to improve the land significantly. They did not destroy it through plowing because they did not have the implements.

Fire, natural or man-made, is the last of the natural forces affecting the Plains. Together with the buffalo it helped to hold the forest back from the prairie. The other very important factor controlling tree expansion on to the Great Plains is lack of rainfall. Where grasses and forbs prevail against trees, as on the plains, there is only occasional rainfall to keep those plants alive and sometimes even they suffer from lack of moisture. There is not enough rainfall to sustain a natural succession of trees. From approximately the hundredth meridian westward, the average annual rainfaull is less than 20 inches. But even those 20 inches or less cannot be depended upon. Where the least rain falls, it is also the least dependable. "Droughts come so frequently that they should be anticipated by the landuser, and accepted by all residents as a regional handicap" (30-294).

Grasslands are made up of three strata, the roots, the ground layer,and the herbaceous layer. The root layer is very much pronounced in grasslands, half or more of the plant is growing beneath the soil, which during the wintertime is representative of almost the total grassplant. The depth to which the roots of many grasses extend can be many feet. Little bluestem has roots reaching down four to five and a half feet. Its roots form a dense mat up to two and a half feet deep. The roots of blue grama and buffalo grass grow vertically to three feet. The roots of grassland plants develop in three or more zones. Some plants are shallow rooted and seldom grow below two feet. Others send their roots down well below the shallow rooted species but seldom more than five feet. Deep rooted plants extend their roots further into the soil. These plants absorb relatively little moisture from the surface soil (40-278). Some of the sod making grass species disperse themselves in bunches when moisture is insufficient to sustain a complete cover. Little bluestem and side-oats grama have adapted to a wide range of conditions.

Dr. J. E. Weaver's book Prairie Plants and Their Environment is the result of fifty years of study of the grasslands of the Midwest. In the preface to the book the publisher states:

> From 1916 until his death in 1966 John E. Weaver studied the grass lands of the Central United States and the ecology of their component species with a single-mindedness of purpose few biologists can match. Two weeks before his death at the age of eighty-two he submitted to the University of Nebraska Press the manuscript of a book which was to be, he said, the final statement drawn from a life-time of ecological research. (47-v)

The major study areas for this work are Nebraska, Western Colorado, Kansas and South Dakota. Weaver made extensive study of the roots of plants.

> The climax plant community has integrated all of the environmental factors of its habitat; it is the fundamental response to the controlling conditions. The individual root habit and especially the community root habit, together with the more familiar above ground parts, serve to interpret the environmental conditions. Both of these criteria are needed to reveal the "judgement" of the plants as to the fitness of the habitat in which they grow or in which crop plants are to be grown.
>
> Frequently, half and often much more of every plant in grass land is invisible. This is the part in the soil. It is the most permanent part and changes but little from season to season. Conversely the parts above ground, the image we recall as prairie, cease growth and die with the approach of winter, and for half the year the living prairie is underground. (47-2)

Weaver describes the prairie as almost monotonous in the general uniformity of its plant cover. The main feature is the absence of trees and the scarcity of shrubs, the dominance of grasses, and a characteristic xeric flora. He states that climate is the most important factor in the development of the character of the flora, especially the ground and herbaceous layers.

The groundlayer of grassland is characterized by low light intensity during the growing season and by reduced windflow. As the grasses grow taller the light intensity at soil level decreases. With the increase in shade soil temperature decreases and windflow is reduced, moisture is conserved. Where mulch can be accumulated grassland can maintain itself, but in areas of little accumulation the grassland deteriorates and weeds invade the prairie.

The herb layer will vary from season to season and from year to year depending on the rainfall. The layer essentially consists of three strata, more or less variable in height according to grassland type. The first stratum is made up by low growing and ground hugging plants such as wild strawberry, violets. These become hidden as the season progresses beneath the middle and upper layer. The middle layer consists of shorter grasses and herbs, such as wild mustard, cornflower and daisy fleabane. The upper layer with the tall grasses consists of forbs which are mostly conspicuous in the fall, such as goldenrod and asters.

Carpenter on Grassland Biome describes the history of the grasslands, the tall grass prairie and mixed grass and short grass plains. He studies the dominants, predominants, and influences, including faunal affinities, mammals, birds, invertebrates, reptiles and amphibians, in his studies of the ecology of the grassland biome (18-617).

Three types of grasslands are recognized by Carpenter as being indigenous to the Great Plains. The tall grass prairie occupied a belt running north to south next to the deciduous forest of the East. Oak-hickory forests did extend into the grassland along streams and rivers on the better drained soils. The prairie fires stimulated a vigorous growth of grass and eliminated the encroaching forest. When the settlers eliminated the fires, oaks invaded and trees advanced into the grassland. Big blue stem was the dominant grass of moist soils and it occupied the valleys of rivers and stream and the lower slopes of the hills. The foliage of the big blue stem stood two to three feet tall and the flower stalk stands three to twelve feet. It was a sod former and occupied perhaps only 17% of the soil surface, yet its foliage was so dense that few plants were able to grow in the under story. Forbs associated with bluestem are goldenrods, compass plants, snake root and bedstraw. Drier uplands in the tall region were dominated by the bunch forming needle grass, side-oats grama and prairie dropseed (40-279).

West of the tall grass is the mixed grass prairie in which middle grasses occupy the lowland and short grasses the higher elevations. The mixed prairie contains largely the needlegrass-grama grass community. Needlegrass and wheat grass dominate the gentle rolling soils of medium texture. The make-up of grasses on the mixed prairie varies greatly from year to year, because of the extremes in precipitation. During wet years mid grasses are prevalent, while in dry years short grasses and forbs are dominant. The grasses are mainly bunch grasses which begin their growth in early April, flower in June and mature in late July and August (40-280).

West and south of the mixed prairie are the short grass plains. The rainfall here is light and infrequent; in the western part 10 to 17 inches and along the eastern fringe 20 inches. The rainfall cannot be depended upon. The humidity is low, the winds high and evaporation rapid. The shallow rooted short grasses use the moisture in the upper soil layers, beneath which is a permanent dry zone into which the roots do not penetrate (40-281). Sod forming buffalo grass and blue grama are the main grasses; also found are midgrasses as western wheatgrass, side oats grama and little bluestem. On the wetter locations in the lowlands switchgrass, Canada wild rye and western wheatgrass replace grama and buffalo grass. Because of the dense sod fewer forbs grow on the short grass plains. The one prominent forb found here is Purple Lupine.

However, many grasslands have been modified in their composition by human intervention and only few places have native floras that remain entirely free of exotic invasion or introduction.

Albertson studied 750 acres of mixed prairie located in Ellis county in west central Kansas, 2.5 miles west of Hays. He studied topography and drainage, geology, soils, general plant life conditions, general vegetation distribution and soil profiles. He observed typical upland profile, minor upland profile, the profile of hillsides and profile of lowlands. He studied the short grasses, little bluestems and the big bluestems. Through identification of different grasses, which associate with particular soil textures, and water relations of various soils one could select woody plant materials which might survive. He found that short grasses always were associated with bluish clay soils, highly impervious to water. These soils were found intermittently along lower slopes.

It is obvious that the most far reaching results were obtained by the introduction of wheat. Those settlers of the prairie who came from the Russian Steppe realized, that if this climate could sustain grass, it could do the same for wheat. This insight was the beginning of the transformation of the endless grasslands into what are now endless wheat fields, feeding millions around the world.

Conclusion

This chapter began by commenting on the rise of geomorphology just as the Plains began to be occupied, and the relation between these two historical facts. It ends at the point where the natural landscape of the Plains is about to be converted into an obviously cultural landscape. The insistence throughout this chapter has been on the geological forces which shaped the Plains, the different regions established by geological, soil and climatic considerations, and the relationship between soil and climate (and little else) which produced the grasslands which were the natural landscape of the Plains. If the landscaper must begin to know his landscape by cultivating first the historical perception (as is argued in the first chapter), then these three areas of knowledge (geomorphology, soil science and climatology) are the basis of that historical perception. To that trio must now be added a fourth, history, the record of the conversion of the natural into the cultural landscape.

CHAPTER III

THE FORMATION OF THE CULTURAL LANDSCAPE OF THE GREAT PLAINS

Introduction

The true nomad leaves little trace of his movements across the landscape.

The birth of civilization occurs when man uses landscape in ways that obviously reflect his habits and his cultural level, especially his ability to maintain, to change and to control his natural surroundings. That which is usually called the humanized or civilized landscape is historically an ever-changing mirror of the shifting boundary between man's technical achievements and the limits fixed by the elemental forces of nature.

Man's technology always incorporates itself in social structures and therefore in the history of mankind a true relationship can be observed between social structures and the environment. This is shown particularly in the way human settlements either integrated themselves into the natural scene or encroached upon their existing surroundings. Poverty and prosperity, primitive methods and technical skills, romanticism and materialism, dignity and decadence can all be read in the appearance of man-made environments all the world over. They record his use of land, the pattern of fields, the network of roads and trails, and the distribution of forests and waters.

Lately public opinion has been focused on the significance of our physical surroundings in the urban as well as in the rural spheres. New professionals in the field of landscape planning and regional reconstruction are trying to collect the knowledge and to develop approaches to meet these new demands of an affluent society. There is much confusion about the way in which these environmental problems should be solved. I am not thinking here of matters like the pollution of water, air and soil. Their solution can be found in adequate legal, financial and technical measures.

But so far there is not yet a generally accepted approach to the treatment of the landscape as a whole. Most likely this is the consequence of an insufficient understanding of the character of our rural environment. Too many people still consider the landscape in its present form as a stable phenomenon in a changing world. But change has always been inherent in man's presence in the landscape and nearly all the natural features which attract us today have been at least in part influenced by man.

In the past, man's participation with the land has enriched many countries with a diversified scenery that today belongs to our cultural heritage as much as the historic areas of old cities and the treasures are collected in our national galleries.

However, the needs of today's world differ from those of former times. This certainly does not mean that a contemporary landscape inevitably will have less diversity, or that a monotonous single use environment dominated by industrialized farming will meet present-day requirements. On the contrary, in order to deal effectively with these changes what is needed is a carefully planned construction of the landscape, a new approach towards the countryside based on the actual facts of change. For much of the existing rural scene around us, as Nan Fairbrother describes in her "New Lives, New Landscapes," reflects the interaction of man and environment in a bygone "agricultural age." Nowadays however, a new balance of landscape and land use needs to be found according to the demands of our way of life in the new "industrial era." This insight, once accepted, can point the way to the creation of new, unexpected scenic beauty, but in order to see that we must realize the historic interaction of man and landscape.

The Effect of the Indians on the Natural Landscape of the Great Plains.

Quartenary Human Occupation of the Plains

In a definitive article on early settlement patterns of the Great Plains, Robert L. Stephenson mentions that human occupations of the New World, like those of the Old World, especially on the earliest levels, are difficult to limit within geographic regions. They are continental phenomena, even hemispherical phenomena, and any limitation within spatial confines must be rather arbitrary. There are, though, certain physiographic and ecological regions in which the early complexes bear closer relationships to each other than they do to complexes in other regions. Stephenson states that the Great Plains of the interior of the North American continent are one such region. They have a degree of internal consistency throughout the time span of human occupancy in their physiographic, ecologic, climatic, floral, and faunal characteristics. They also have a degree of internal consistency in their cultural content (48-685).

The entire human occupation of the Great Plains has been discussed by Stephenson under three broad headings: (1) The Paleo-Indian Stage which begins with the first peopling of the area perhaps as much as 40,000 years ago, and ends with the general extinction of the big game animals, the disappearance of the well made lanceolate projectile points, and a general economic dependence upon small game. (This stage probably occupies well over half the time span of man's occupation of the Plains); (2) The Archaic Stage which begins with the end of the Paleo-Indian Stage and ends with the development of agriculture, ceramics, the bow and arrow, and the establishment of semi-sedentary village life; and (3) The Sedentary Stage which begins with the end of the Archaic Stage and ends with the domination of Europeans of the Plains (48-686).

1. The earliest specifically identifiable culture complexes that are found in the Great Plains are each based upon a diagnostic projectile point style, accompanied by a large or small inventory of relatively non-diagnostic artifacts, and associated with a stratigraphic position and faunal assemblage that may or may not be dated by carbon 14. The projectile point styles are quite specific, and they exhibit a high degree of technical skill in stone working (48-689).

The best known Paleo-Indian remains found in the Great Plains so far are from the Llano Culture with large, rough fluted points and fauna including elephants. It is thought to be in the range of 12,000-11,000 years ago; the Lindemeyer Culture, with smaller well made fluted points and a fauna that included extinct bison in the range of 11,000-10,000 years ago; and the Llano Culture, with large, well made unfluted lanciolate points, and a fauna that included extinct bison is thought to be in the range of 10,000 to 8,000 years ago (48-689).

2. The Archaic Stage is thought to begin with the introduction of corner-notched projectile points at a time when the general ecological situation in the Plains had shifted, and man's economy could no longer depend upon the large game animals. The fauna was made up of small animals, and there are implications of a greatly increased economic dependence upon a large variety of foods such as rodents, birds, small mammals, fish, and especially vegetable products. Peoples of the preceding stage utilized these foods too, but only as secondary items in the economy (48-691). The time range for the Archaic Stage has been proposed as beginning 7,000 or 8,000 years ago and lasting to as recently as 1,000 or 2,000 years ago.

3. It is not known exactly when the Archaic stage was replaced by the next, the Sedentary Stage. The change was gradual to a more elaborate and complex way of life. Larger groups of people were living together in communities of gradual increasing stability, with semi-permanent dwelling structures, and much attention paid to the burial of the dead. Experiments with the planting of crops gradually developed into an economic dependence on agriculture. Pottery containers became a household necessity. Dates for these early sites are inconclusive, but a general time span as of 2,500-1,500 years ago has been given.

Following these early semi-sedentary cultures in the Plains is a period that is referred to as fully sedentary. It includes permanent villages which appear to have been occupied continuously for at least a century or two. The structures were concentrated along the major rivers and streams. The economy was based upon agricultural crops, but hunting, gathering, and fishing were equally important. Food was stored from season to season in large underground storage pits. Well made pottery was abundant and many kinds of stone, wood, bone, and shell tools were in use. The villages were usually large, especially the later ones, with as many as a hundred houses in a single village. The suggested period time span is 1,300-500 years ago (48-693).

A final development in the Sedentary cultures of the Plains is represented along the middle Missouri River by villages of circular earth lodges, with or without fortifications. The circular earth-covered house with four central roof-support posts, a central fire-place, and covered entry way was a very different type of dwelling from the earlier rectangular house. The villages ranged in size from only a few houses in some sites to as many as 200 or 300 houses in others. Dated sites indicate that the circular house villages made their appearance in this area about 500-600 years ago. This was a time of heavy population density along the middle Missouri River Valley. The last such village, known as Like-a-Fishhook Village in central North Dakota was abandoned less than a century ago. It belonged to Mandan, Arikari and Hidatsa people (48-694).

In Nebraska and Kansas, similar changes were taking place in village and house patterns. The circular house of the Pawnee replaced the earlier square house, and population centers shifted to the major stream valleys. Farther south in southern Kansas and Oklahoma the change was to the large, circular, grass-covered houses of the peoples known historically as the Wichita.

With the influx of white explorers, traders, and settlers into the Plains area during the 19th century, the Indian sedentary way of life gradually came to an end. Briefly an incursion of horse nomads, such as the Sioux, Cheyenne, Comanche, and others, swept the Plains, contributing to the end of the sedentary cultures. But they, too, were reduced to virtual oblivion by the overpowering civilization of the white man (48-694).

Few people have been as self sufficient as the Plains Indians while at the same time professing to be so dependent upon forces outside themselves. To them the Plains resembled the ocean--vast and mysterious. Far from seeing himself as master of his environment, the Indian felt adrift on a great sea of whispering prairie grass. He was always searching for the life-giving buffalo that symbolized for him and his people the miraculous world of nature.

The Plains Indians drew no clear distinction between the natural and the supernatural. They paid as much attention to the one as to the other. They believed that all things had spirits and that these spirits controlled the natural world. Under such circumstances it is not difficult to accept that the Plains Indian believed himself to be living within a web of supernatural powers. He felt that his survival depended upon maintaining contact with these powers. He became a seeker of visions and a practicer of rituals, devoted to ceremonies that would bring him into partnership with the cosmos.

No aspect of the Plains Indian life reflected this harmonious fusion of the natural and supernatural better than the buffalo hunt. A buffalo hunt was very carefully organized. For the hunt to be successful, little could be left to chance. Animals were slaughtered till all needs were met. Once killed and butchered, there was little the buffalo did not provide. From the carcass came fresh meat and meat which was dried for leaner times. The skin provided blankets, moccasins, mittens, shirts, leggings, dresses and underclothes. Sinew was turned into thread and bowstrings; bones into farm tools, horns into cups and spoons, while the stomach was turned into a water bottle. The rough side of the buffalo tongue became a hair brush.

The Plains Indian is best known as a wanderer who traveled by horse to follow the buffalo. He was indeed a nomad, but it should not be forgotten that the horse was a latecomer to the plains and that for thousands of years a few tribes had been farming the more fertile parts of the region as well as hunting buffalo. In the 18th and 19th centuries, this pattern persisted along the upper Missouri and in present day North Dakota where tribes continued to live in permanent earthen lodges to farm, and to hunt buffalo only part time.

For most of the Indians of the far western plains (such as the Comanches, Apaches, Blackfeet and Sioux) life was truly nomadic. They might pursue the roaming buffalo for hundreds of miles, taking food, clothing and shelter with them packed on their travois. The hunting grounds of various tribes were only vaguely defined, and inter-tribal contact was frequent, especially for trading purposes. On such occasions the nomads would barter their buffalo pelts and meat for corn and other agricultural products raised by the more 'homely' peoples living on the fringes of the plains.

Before the advent of the horse, the plains were populated by a few scattered tribes who found hunting buffalo on foot a risky business at best. It is amazing that for almost a century and a half after the Spanish explorer Coronado's trek from Mexico into the plains in 1540, the Spaniards were quite successful in keeping their horses out of Indian hands. However, the horse spread rapidly northward after 1680 when the Pueblos rose in revolt and Spain's grip on the Southwest loosened. By 1780 the plains tribes were making full use of the horse, which made the buffalo hunt much surer. By this time the population of the region had tripled to an estimated figure of 150,000 (13-34). Much of the vitality of the Indian culture from approximately 1780 to 1880 was the result of the Indian adoption not only of the horse, but also of the gun and metal tools.

It is fortunate that artists such as George Catlin, Carl Bodmer, Paul Kane, Friedrich Kurz and Alfred Jacob Miller, as well as Indians themselves, created a vivid accurate pictorial record of plains life. Charles Russell's painting, Caught in the Act, 1885, shows the plunge the Indian Plains civilization took after a very brief high from about 1840-1890. The canvas depicts a starving Indian family reduced to stealing ranchers' cattle and being caught by two cowboys. The landscape is a cold grey white winter scene on the plains with its small shrubs and few small twisted trees silhouetted against the cold sky.

This scene which depicts the end of a civilization is so strikingly different from a buffalo hunt painted by H. G. Hines in 1847. That painting shows an Indian hunt, the central act of his life, over a vast expanse of the plains with the unlimited space, the green-yellow, the warm sky and the abundance of buffalo.

The two pictures hung side by side would make one wish we would understand.

Blanket Elk
Standing, looking straight
Hoping to see buffalo
Lonesome
Blanket Elk

by Floyd Runing Hawk or Sioux
Sixth Grade
Red Cloud Indian School
Pine Ridge Reservation
March 22, 1974

Before the agricultural exploitation by European man, the region was essentially a treeless prairie, having stands of trees and woody shrubs mainly along water courses. The original prairie contained a wide variety of grasses and other herbaceous plants, large numbers of compositae and many less-common plants.

The effect of the Indian on the Great Plains natural landscape has been limited. He lived in a balance with his environment. The fires which he set by accident or on purpose can be regarded as part of the natural cycle, because natural fires caused by lightning were one of the means by which nature kept the forest encroachment on the prairie under control.

From the Blackfeet of southwestern Canada and the Sioux of Minnesota and the Dakotas, to the Cheyenne of Colorado and Wyoming and the Comanche of northern Texas, these tribes possessed a generally uniform culture, although they differed considerably in temperament and language. All lived by hunting the buffalo. At that period in history the cultural landscape overlaid the natural landscape very lightly. Neither buffalo, nor horse, nor Indian village, left permanent traces on the natural landscape, and whatever remains is now found only under its surface. This light interaction of man and nature, a cultural landscape almost identical with the natural, is both the prelude to the making of the cultural landscape now existing and a condition that environmentalists tend to think is ideal. But it is not the basis for making a regional functional landscape today.

Settlement Pattern of the Great Plains

F. J. Turner described the frontier as a moving line westward, it was the most advanced region of settlement. This frontier was thought of as an imaginary line between civilization and wilderness. The United States census reports defined the frontier as that area having less than six but more than two people per square mile. From colonial times to the end of the 19th century, a period of almost 300 years, the frontier was part of the American environment and was constantly on the move westward. In 1650 the frontier was along the Atlantic coast, by 1750 it was at the foothills of the Appalachians, by 1840 at the Mississippi River, and by 1870 in the Great Plains. The west was sufficiently populated by 1900 for historians to consider the frontier closed.

The migration to the west came in four waves. First came the adventurers, then the nomads such as hunters, trappers, fur traders and explorers, then the land-hungry frontiersmen who tilled the soil while waiting to sell their land to later arrivals and move on themselves and, finally, came the permanent farmers who purchased land and remained. The need for goods for the permanent settlers attracted the tradespeople and professionals from which the villages and towns arose and prospered. This pattern of settlement was repeated time and again as the frontier moved westward. It should be remembered that once the frontier had reached the open prairies--the plains--the people did not immediately settle there but moved across it to the far west--California and Oregon. When those areas were settled, people looked again at the land they had crossed and some returned to settle it.

The westward movement was a continuous process but immigration to the frontier was greatest in a succession of periods, each following turmoil in the east. The first period was after the American Revolution; economic distress in the East, the removal of British restrictions on westward settlement, and the generous provision of the Northwest ordinance (1787), all encouraged the western movement. The Northwest ordinance was a significant model for the occupation of the Great Plains. As soon as any territory contained 5,000 male adults, these inhabitants could elect a territorial legislature which, together with officials appointed by Congress, would rule the territory. As soon as any territory contained 60,000 inhabitants, these inhabitants could adopt a constitution and apply for admission to the Union.

Movement west continued following the war of 1812. This was because of the decline of New England's shipping industry, the rise of nationalism, the lessening of the Indian menace, and heavy immigration from Europe. Another wave of settlement followed the Mexican war (1848) because of the discovery of gold in California. Finally, following the Civil War (1865), free land under the Homestead Act (1862), the construction of transcontinental railroads, and again heavy immigration from Europe, all encouraged the final intensive settlement of the Great Plains.

General population distribution of the United States between 1790 and 1850 was:

Year	Total U.S. population	Population west of the Appalachians
1790	3,900,000	100,000
1830	13,000,000	3,700,000
1850	23,000,000	10,000,000

Apart from a sense of adventure (The west, with its wild animals, Indians and unexplored regions, attracted men who sought the thrill of adventure and discovery.) many easterners looked upon the west as a place where they could improve their economic status. There was a plentiful supply of fertile land, as well as other natural resources, including timber, gold, silver, copper and iron. There was opportunity for greater social and political democracy because as the eastern states became more settled class distinctions appeared and democratic reforms were delayed. Historical perception (desire for democracy) and functional need made men see the Plains as their place of settlement.

The federal government by its land policy sought to encourage rapid settlement of the western lands and provide a steady source of income for the Government. According to the provisions of the Land Act of 1785, the western lands were surveyed and divided into rectangular townships of 36 sections each, a section being a square mile, or 640 acres. One section of every township was reserved for education. The land was sold in 640 acre sections at $1.00 per acre, which was later raised to $2.00. However, 640 acres was too much land for the average farmer to buy and to cultivate. Consequently in 1820, a law was passed that enabled settlers to purchase as little as 80 acres at $1.25 per acre.

The West was not satisfied merely with cheap land, but demanded free land to attract more settlers. It was not until 1862 during the Civil War that the Homestead Act was passed providing 160 acres of land, free to any citizen who would live on and cultivate it for a period of five years.

As a result of the Homestead Act a vast number of people immigrated to the Great Plains. These people, known as homesteaders, fenced off land for farming, but met the opposition of cattle ranchers who wanted to keep the open range for free pasture of their stock. However, the cattle ranchers were not able to stem the tide of the land-hungry settlers. The natural landscape was to become a cultural one and its appearance was determined by laws devised in the East.

The Effects of Early European Settlers on the Natural Landscape of the Great Plains

The first Europeans to see the Great Plains did not settle there but traveled through. They were explorers and later gold seekers tracking across to California. Their impact on the landscape was in the form of wide trails such as the Oregon and Santa Fe along which people and wagons moved west. The trails were wide since this permitted better traveling when wagon ruts had eroded too deeply.

From the beginning of exploration the area was regarded as a spatial barrier, a monotonous, treeless expanse, inhabited by Indians and without enough rainfall to supply the necessary water requirements for men and their livestock. The people who sent reports from the area during the California gold rush of 1848 probably observed the plains during an especially dry period, which accounted for their reports of rolling wasteland unfit for cultivation. When people came to look at the land as a potential habitat, a cycle of normal rainfall had returned and the land looked more promising. This was near the end of the Civil war when most good farmland east of the Mississippi already had been claimed. War veterans and European migrants set out upon the Plains looking for farmland.

About a hundred years ago there was a western boundary line on maps, east of which the land was settled with a population of 38,500,000. Perhaps a million lived west of this line either in California, Oregon, Utah, Colorado and New Mexico. This line followed somewhat the 97th meridian, which runs due north and south some fifty miles west of the Minnesota-North Dakota line, passing near Wichita, Kansas, and again some miles west of Fort Worth. At that time more Americans were engaged in agriculture than in any other occupation, except in industrialized New England and the Middle Atlantic States. The lowest population density was to be found in the frontier lands of Kansas and Nebraska.

In addition to trails running from east to the west, there were trails running from south to north also. These were the cattle trails which began with the annexation of Texas in 1845, when ranching and cow punching came into American life. Mexicans had designed the bit, bridle, saddle and spurs, the lariat, chaps and the five gallon hat of the traditional cowboy. For centuries they had broken broncos, grazed calves and roped steers, but one thing they did not do was use the branding iron. So when Americans from Missouri, Mississippi, Alabama and Tennessee began to trickle into Texas in the 1820's many of them simply put their brands on what they thought to be wild herds and instantly became cattle kings. It was instant ranching. Other Americans at that same time were catching horses and cattle that had broken away from the Mexican herds and had wandered northward. In this manner the range and cattle industry started in Kansas and Nebraska. These ranchers supplied beef and fresh horses to immigrants going farther west and to mining camps and railroad crews. These northern herds were small compared to the herds of Texas, but they also helped to change the face of the landscape of the Plains and set the stage for more to come. And more changes came.

In the 1850's some of the more enterprising Texas ranchers undertook to drive their cattle westward to Colorado and California markets or northward to Illinois. But these drives were uneconomical. By the end of the Civil War, Texas ranchers had large herds, and they began looking with new interest for markets. When they learned that steers which sold for no more than $3.00 or $4.00 in Texas would fetch as much as $40.00 a head on the northern markets, they decided to drive north. The first drive to Sedalia was a failure but it set the stage for more to come. The trail to Sedalia crossed over some new Missouri farmland where protesting 'nesters' came out with their guns. This was a scene which was to repeat itself in years to come.

By this time another inroad into the Plains landscape had taken place, the railroad. An enterprising Illinois meat dealer, Joseph G. McCoy built a hotel and barns, stable, pens and loading chutes at Abilene on the Kansas Pacific railroad which with the Hannibal and St. Joseph and other railroads connected Abilene with Chicago. In 1868, Abilene received 75,000 head of cattle, and by 1871 the number had soared to 700,000 (16-503). As the Kansas Pacific was extended westward across Kansas, new cow towns nearer the cattle range were used. Ellsworth, Kansas, which succeeded Abilene, received over a million head between 1872 and 1875. Next came Dodge City, to which another million head were driven between 1876 and 1879.

Now ranchers flocked to the range. Returns of 40 or 50 percent were common in the early 1880's, but by 1885 the range grew over-crowded. A disastrous winter in 1885-1886 followed by an extremely dry, hot summer destroyed most of the feed and cattle. And at this time the sheepherders began to cross the range in large numbers. Their flocks caused wide swaths of barren range.

The expansion of ranching with the growth of the railroads combined to cause the obliteration of the buffalo. Like everything else that was happening on the Great Plains, it happened very rapidly. By the end of 1870 most of the buffalo were gone. Cow chips replaced buffalo chips. And the range lay open to a more severe change: settlement.

To help landseekers, Congress passed in 1862 an act to enable settlers to claim without costs homesteads of 160 acres. Permanent title to the land could be obtained by living on it and improving it. An earlier act of 1841, which provided preemption rights to 160 acres of public land, put a price of $1.25 on an acre of land. Many Southerners who could not claim land under the homestead act because they had fought in the Civil War made use of this earlier act, but settlement of the Plains was mainly accomplished by Union veterans or European emigrants who had applied for citizenship.

In 1873, at the height of the Great Plains land rush, a third provision known as the Timber Culture Act enabled settlers to acquire an additional 160 acres by planting 40 acres of trees and cultivating them for periods of eight to ten years. Some of those groves of oak, walnut and other trees can still be found on the Plains. It was hoped that additional tree planting might change the climate of the Plains and result in increased rainfall. Since far too few settlers complied with the provisions of the act, it was repealed in 1891.

Another important source of acreage for settlement was railroad land. Transcontinental railroads obtained not only huge loans but also as much as forty sections of land (25,600 acres) for each mile of track laid. During the 1870's and 1880's the railroads engaged into high pressure efforts to convert their land into cash. They flooded the Eastern states and northern Europe with glamorous advertisements and such posters as:

> "Come to the Garden of the West!
> Come to Kansas!
> Come to Minnesota! Come to Nebraska! the Great Platte Valley.
> Purchasers, their wives and children carried free in our
> elegant day coaches.
> Red River Valley Lands. Homeseekers!
> A farm for $3.00 per Acre
> Every Farmer, Every Farmer's Son,
> Every Clerk, Every Mechanic, Every
> Laboring Man can Secure a Home."

The result was an even greater flood of humanity across an area which only a few years earlier had been declared unfit for living. But although the Homestead Act of 1862 opened the West to free settlement under liberal conditions, much of the best land was appropriated before homesteaders could get to it. And there were greater problems.

Even though the quarter section (160 acres) offered by the act was large enough to farm in the Mississippi Valley or New England, it was either too large or too small for the arid, treeless plains. For the small settler, breaking enough of the 160 acres to get a paying crop, constructing buildings, and buying equipment were costly affairs. The Department of Agriculture estimated that wood fencing alone for such a farm would cost $1,000.00. For the large farmer, willing to use the costly new machinery so well fitted to the broad expanse of the plains, a mere quarter section hardly justified the investment (16-506).

All told, between 1862 and 1900, 80 million acres were registered under the Homestead Act. During the same period, railroads, land companies and states receiving grants of Federal land under the Morrill Act of 1862 sold at least five or six times as much land. These sellers charged from $2.00 to $10.00 an acre, depending on distance to transportation and markets.

With homesteading came the need to control livestock, and in the treeless plains this was a problem. Where farmers in the forested east had used the railfence and could afford the extravagance of the snake fence, on the Plains there was not even enough timber to find sufficient posts, let alone to cut rails. The solution was found in the barbed-wire fence. In 1874, three different inventors patented barbed wire fences. This gives some indication of the urgency with which people were looking for a solution of how to control and improve their livestock. For cattlemen, the barbed wire fence was the end of the open range and trail drives. One cattleman expressed the feelings of all when he wished that "the man who invented barbed wire had it all around him in a ball and the ball rolled into hell" (16-506).

If one were to look for one single way in which the settlers changed the landscape of the Great Plains, it is undoubtedly the use of the barbed wire fence. This allowed the wide plains to be cut up into small sections and set the trend to intensive farming. It controlled land use to the extent that the lowlands could be used for crop production with certain assurance that cattle could be kept out.

It changed the landscape of the Plains by placing homesteads every mile or so. The stage was set for an agricultural landscape, the first cultural landscape obviously enforced on the Great Plains.

A land use pattern was rigidly imposed on the land, closely adhering to survey lines running north-south and east-west with roads along the straight boundaries of each section. It was a grid system carried to its ultimate with no respect for topographic changes. This resulted in the quilt-like landscape we fly over today. Even the town streets emphasize this grid pattern on a more intensive scale. The only variations are afforded by the slow and lazy rivers which flow and meander as they always have done before. Their courses underlie the grid's rigidity and are a welcome interference, though undoubtedly generations of engineers have wished they too would run with the grid! In the mixture of meandering and straight lines we can see most obviously the importance of a cultural landscape on a natural one.

The Plains received the imprint of American organization of space. This was the last region not only to receive it but also to retain it. The square homestead setting in a corner of the square section reflects the pattern of the square township, a geometrical pattern is softened by the rolling terrain, the woods, the valleys and streams. A linear culture impressed its grid on a curvilinear landscape (all natural landscapes are expressed in curves); previous cultures--Indian, nomad, rancher--had followed the natural curves and not obviously impressed their culture on the landscape. The new landscape of the Plains was henceforth to be cultural and not natural. But the natural landscape still had its trump card to play--the climate.

The Evolution of a Cultural Landscape on the Great Plains

In every age man has had a specific functional relationship to society that determines how he thinks about himself. He is a product of the evolutionary demands of his time. How he behaves is ultimately related to what he must do to survive.

In very early times these demands were largely physical. In the settling of the Plains the first demands again were survival but primitive man did not have either the technical skills or sufficiently large numbers to upset the ecological balance. The settler, once he survived the first bare minimal demands, was soon able to modify the land with his modern technique of farming and his greater skill. (But his need for profit pushed him beyond the limits of a natural balance which led to overstocking and overplowing, setting the stage for the later dust bowl.)

The natural landscape of the Plains which has often been described as a 'sea' had the same distinct power to the travelers who crossed it as the ocean had on seafaring people. It aroused one's interest to investigate what was beyond. Early treks across the Great Plains must have called the people on. When mist lies over the Plains they become even more like a sea. However, the Plains gave a far more secure feeling than the sea after they were inhabited--they were now human.

Before the new settlers of the Plains could transform the country into farmland they had to overcome many obstacles. On the treeless plains not even rough loghouses could be built. The first shelters were often dark sod huts, from dugouts built against slopes to very rare two-story houses. One sash window frame furnished light for the interior and if no lumber was available the doors were made of slatted poles covered with canvas. Barns, sheds, the first schools, churches, and sometimes courthouses were built of sod where no wood was available. Here the invading culture could not at first impose its form of housing on the landscape; it had to borrow from the culture it supplanted.

The sod houses were derived from the earthen lodges of the Pawnee Indians. The buffalo grass sod was very suitable for this, plowed into even thickness and even widths. The strips of sod were cut into even length with a spade, generally into sections a foot wide, two feet long and three inches thick. These blocks well laid provided a smooth wall and a home warmer than any other which could be built in the Plains winter climate and cooler in the Plains summer.

Mary Sandoz, in the book Old Jules, named after her father, was one of the first settlers on the Nebraska sandhills; she describes homesteading in all its painful detail as it affected the men but especially the woman.

> Mary's practical eye appraised the homes on the flats, soddies, dugouts, unpainted frame houses often with dead sunflowers choking the yards--one look inside the house firmed Mary's long chin. "Have you no water and no soap in this country?"--After supper Jules interrupted the cleaning again. The entire west was a sheet of rose, with the Minten house and barn two dark blocks against the sky. A path of red gold rippled on the river. It recalled a childhood rhyme to Mary. Something about, "Fire, Oh! The Rhine is burning!" with a final quenching by a hundred thousand croaking frogs. "That is a fine sight," Jules pointed out, hoping to please. But the pain for Switzerland and all it once meant to her, closed the woman's throat. (34-184)

This is a fine example of the clash between esthetic appreciation of the natural landscape and the immediate functional needs of the new culture.

The lack of wood to build houses also made it difficult to heat dwellings. The first settlers used dried buffalo dung to try to heat their homes. The Indians had done the same. Hay next became a common fuel, in special stoves designed to burn it slowly. But nothing proved satisfactory until the railroads brought coal to the Plains.

The majority of homesteaders who first came to the Plains engaged in agriculture to sustain themselves and their families. Few of them could afford the crude farming machinery of that time and many a first crop was put in with hoes, spades and mattocks. Plowing was extremely difficult especially where the sod was formed of native buffalograss. And for those whose homesteads were distant from a dependable water supply water was another problem. It was not unusual for a Plains farmer to haul water in barrels for several miles over a period of a year until he could dig a well.

Though wells could be dug the necessary 200 or 300 feet, there remained the problem of getting the water to the surface. Windmills that harvested the power of the prevailing breezes provided an answer but they were still an expensive item and sometimes if there was no wind someone had to climb up and rotate the wheel so water would be pumped up. Today the Plains landscape is still dotted with many of such windmills some still functional and doing their old job and many have succumbed to the times and stand broken down.

In the east the policy had been to have many small fields of ten acres square. Each field was often surrounded by a stout fence but in the 1860's mechanized farming equipment called for larger fields for maneuverability. The tendency was to raise two or more commercial crops--wheat or corn or hay--instead of a variety of crops for home consumption.

The size of the fields continued to grow and farms grew larger especially in the more stable rainfall areas. After the Civil War a wheat farmer in Minnesota, Oliver Dalrymple, farmed 2600 acres in one crop--wheat. He had this acreage divided into three farms called "Grant," "Sheridan," and "Sherman." Later he farmed even larger acreage and had fields totaling 14,000 acres under wheat. This expansive farming was only possible with the new inventions of farm machinery and transportation. At first the favored areas for raising wheat had been near the rivers where transportation of the grain was possible by boat. But the railroads opened up lands away from the rivers for wheat. Farmers went to much nearer depots and grain elevators punctuated the prairie and Plains skyline. The cultural landscape as we know it today was almost complete, an interaction of vertical lines and horizontal lines, especially fences.

With the increase in acreages came the need for improved plows. John Deere's steel plow was such an improvement but still expensive. In 1868 a chilled iron plow was invented by James Oliver of Indiana which by 1877 had become a cheap versatile and efficient tool. The next step was to make plowing easier by riding a sulky to which one or more plowshares were mounted. By 1874 grain drills had been designed to mechanize planting. The "cord binder" was perfected about 1880 and greatly speeded up the harvesting process. The ability to harvest quickly was a necessity in a region where hail and windstorms and sudden frosts could ruin a crop.

Joseph F. Glidelen, one of the three independent holders of a patent on barbed wire, set up the first barbed wire factory in DeKalb, Illinois, in November, 1874. By 1876 barbed wire was in mass production. That year, 3 million pounds of barbed wire were sold at about $20 per hundred pounds. Four years later sales had risen to 80 million pounds and the price had been cut to $10 per hundred. By 1890 the price was down to $4.00 and much of the arable land of the Plains had been fenced in, most of it for wheat growing (16-508). Nineteenth century farmers of the eastern United States generally did not plant more than eight acres of wheat. By the year 1890 one Plains farmer with a cord binder could hope to harvest 135 acres.

The easterners, who grew a soft-kernel winter wheat, usually planted their crop in September or October. They let it grow during the winter and harvested it in June or July. This could not be done on the Plains as the early winters killed the tender seed before it could sprout. Spring wheat, planted in May and harvested before the first frost, had been known to farmers before 1860, but those known varieties lacked hardiness and were difficult to mill economically.

When two hardy winter wheats were introduced, one from Poland in 1860 and the famous "Turkey Red" by settlers from Armenia who settled in Kansas in 1872, and new processes for milling these varieties economically had been developed, the Plains landscape changed to more and more rectangular fenced fields of wheat crops which still today produce the typically quilted landscape of the plains.

All the great improvements in American farms' technology coincided with the growth of the European market for more and more wheat as western Europe turned from a farming to an industrial society. In turn, the image of the city "back east" tantalized the early settlers to think of their own little towns in terms of the future, a future that some of them did realize. In the Midwest and the Plains states the landscape architect, Horace Cleveland, in the seventies noted how every whistle stop confidently looked forward to becoming in the near future an important city. Its unpaved, untraveled streets were appropriately broad; the rows of stakes marking the still unsold lots extended for miles (19-22). Anthony Trollape wrote in 1862: "I could hardly believe that in these days there should be a living village of drawn wagons and visiting Indians with painted faces and one hotel, closed for lack of business. But it was soon on its way to becoming the flour producing center of the nation" (19-46).

The free landscape was thus changed by the homesteaders and their descendants into a largely agricultural landscape with a distinct landscape character, which is seen sometimes in close detail. The controlled grazing often resulted in a browsing effect under the shade trees of great pictorial beauty. The browsing line was often parallel to the undulating ground surface. This was a unifying element in the landscape composition in a sense unnatural but not unattractive. At the same time the elimination and selection of plant material through the grazing process, leaving only a few kinds of trees and shrubs, has a somewhat unifying effect and is also not displeasing.

Though there was little room for hauling plant material for esthetics on the early wagons going west, often a woman was able to take a cutting along of a favored shrub or ornamental tree. But the commercial crops which claimed high space priority on the wagons soon put a stamp of the east, or the old country, on the Plains landscape.

We don't always realize that many of our improved pasture plants came from the old world. Timothy, bluegrasses, and clovers provide an entirely different color scheme to the agricultural landscape than that of native plants. The same goes for many of the introduced trees; the apples as well as the ornamentals hold their green leaves much later in the season. In the fall the European grasses are much greener and stay greener longer in the pastures:

> In early Autumn almost unnoticed the prairie grasses on the ridge tops and along the railroad are passing into their own exuberant display of fall color. In strong clumps the wiry stems of turkey foot rise shoulder high. Their short stubby tassels branch out abruptly from the tips of the stem. All summer these grasses have been a fairly uniform green. Now the narrow leaves are reddening, the stem is turning gray-blue, the tassel itself reddens into a strange bright brown like a Harris tweed. The little blue stem, a close relative and ancient prairie comparison of the turkey foot now shows why it too deserves the name the pioneer gave it. The stems and leaves are so richly patterned with color that one needs to take them home and view them against a neutral background to fully appreciate their beauty and intricacy. The stem and much of the leaves are overlaid with a bloom of a celadon blue. At the joints along the leaves and in the silky tassel, are lines and splashes of Chinese red, rich brown and bright yellow green. (2-10)

The cultural landscape was now in place down to its least and last detail--the colors of introduced grass strains. Both the natural landscape it overlay and some aspects of the cultural landscape itself were capable of being appreciated for their beauty and hence capable of creating not only a cultural landscape but a culture itself. Before that could happen, however, the climate had to be taken into account, and it had not yet shown the extremes of variability of which it was capable.

The Effect of the Climate on the Evolution of the Cultural Landscape of the Great Plains

The climate of the Plains is one of contrast. Winters are nearly 50 degrees F. warmer in southern Texas than in North Dakota, but cold polar air can suddenly sweep down into the Gulf States. In the northern parts of North Dakota the growing season lasts only 3 to 4 months as against 8 to 9 months in Texas. Midsummer days can be as hot up north as down south. But whatever the heat or cold may have meant to the early settlers, the greatest landscape influencing factor has always been the rainfall: over the region in general rainfall does not greatly exceed evaporation; drought then is the chief hazard.

The moisture-laden air from the south meets the cold polar air and is forced upward and chilled; it condenses and down it comes as rain. But most of the moisture-laden air from the south moves eastward; consequently the rain does not fall on the Great Plains. If the moist air does move westward and reaches the Plains, the rainfall generally is very heavy. But most of the warm air that does reach the Plains comes from Mexico and is so dry that after it meets the cold air little or no rain results. Spring frosts, hail, hot winds during the summer are other climatic extremes of the Great Plains. The average annual rainfall along the eastern fringe is 38 inches, and along the western boundary less than 14 inches.

When the settlers saw the Plains they first worried only about how to cross them to California or Oregon. When by the mid-1800's they looked at the Plains to settle, a need for water forced them to settle along the stream valleys where water was available and trees provided lumber to build, wood to burn, and generally a more livable landscape.

A period of above-average rainfall encouraged more settlers to move in. Then when the drought came in the nineties many left again. When climatic reverses exposed the true marginality of this land, the Congress passed the "enlarged" Homestead Act in 1911, allowing each settler 320 acres, and when even a half section proved inadequate for the support of a family, the size of the farms was doubled again with the "stock raising" Homestead Act of 1916. But in the low rainfall areas of the western plains, even that acreage was too small.

It is interesting to note that John Wesley Powell, the explorer, in 1897 recommended that in the dry west a farm unit should not be less than 2,560 acres. He also stated that pasturage farms need small bodies of land which can be irrigated, and that the division of these lands should be controlled by topographic features to have water fronts. Residence of pasturage lands should be grouped; the pasturage farms cannot be fenced but must be occupied in common (30-298). Today we do have the larger farms, even larger than the minimum suggested by Powell, especially along the western fringe of the Plains where rainfall is less and more eratic. But this is also the area where farmers have invested in irrigation and are still investing $50,000 to $90,000 and more in huge irrigation systems. A serious consequence of this is that we are now mining the water, taking it out of the ground faster than it builds up. The result of these modern trends is a vastly changed landscape from near arid to an apparently sufficient supply of water to grow vast acreages of crops.

Throughout the Great Plains the drought hazard is greatest in winter and least in late spring and early summer. Drought periods of 35 or more consecutive days may be expected annually and periods of 60 and 70 days once in 10 years (21-180). This fluctuation of the climate within wide limits creates one of the most serious climatic risks to agriculture. In some years the amount and seasonal distribution of the rainfall is adequate for successful agriculture and in others the rainfall is so reduced that crop production is impossible. In the western Great Plains, the rainfall surpasses that of semi-arid climates with sufficient frequency to encourage agriculture but not enough to make successful agriculture possible over a period of years without the benefit of supplementary irrigation.

Dry farming was thought to be another method to control the effects of droughts. The aim of dry farming was to conserve the little moisture which fell by reducing runoff and evaporation and increasing absorption to a maximum. Through summer fallowing and maintaining a dust mulch through cultivation after every summer rain the moisture could be conserved. But in the process of moisture conservation, soil structure was destroyed, and the result was wind erosion of the soils.

But in the early thirties the climatic pattern changed; droughts were experienced in the northern and central Great Plains. By the mid-thirties nearly all the region was affected. The result was a second emigration from the Plains region between 1930 and 1940. The period from 1920 to 1940 resembled the earlier period between 1880 and 1900: a number of rainy years was followed by a disastrous drought. Also both wet periods occurred when there was demand for more farm land. The result was immigration of people and extension of the cultivated areas and overgrazing. When the drought struck emigration occurred. In both cases the series of rainy years had been mistaken for normal climate with the resulting dissolution.

Walter Prescott Webb in his article "The American West" forces us to look at the heart of the west, the desert states:

> The overriding influence that shapes the west is the desert. That is its one unifying force. It permeates the plains, climbs to all but the highest mountain peaks, dwells continuously in the valleys, and plunges down the Pacific slope to argue with the sea.
>
> It shortened the grass on its borders before destroying it in the interior. It never permitted trees on the plains it built, and where it found them it beat them down to sage and brush, reducing the leaves to thorns and sap to grease and oil. The trees it could not destroy it shriveled, and those it could not shrivel, it petrified. (10-157)

The reason we do not understand the west, says Webb, is because we refuse to recognize that the desert-like conditions exist--we do not want the desert to be there. We prefer to loiter on its edges, shirk it, avoid it, and even deny it (10-158).

It is interesting to read that until after the end of the Civil War, school maps showed the Great American Desert east of the Rockies. After the Civil War the name was abolished as people moved in to settle the desert rim states, the Great Plains. Omitting the name on the map did not change its characteristics, but concealed them in the periods of hope, while there was above average rainfall.

Though many farmers left the Great Plains during the periods of drought, there is for many a strong social identity with the large scale environment of the Great Plains, and a sense of belonging that outweighs the physical disadvantages. A survey of midwestern dust bowl farmers, many of whom refused to relocate when the opportunity came, showed that for 88 percent of them the elements of conflict, risk, and uncertainty in their way of life were integral to their self-image. Pride in their ability to stick it out overrode the inhospitable environment which in turn had conditioned them to just such pride (8-15).

Demsey writes:

> In the nineteenth century America, patriotism was more likely to find expression in the grandeur of nature than in the glory of military victories. As a country we had no power at all. As a culture we still borrowed most of our sensibility from the old world. But as people we had conquered the plains and mountains. Our landscape painting, even the relatively subdued and gentle work of the Hudson River school stirred men to appreciate their land as something both intrinsically beautiful and symbolic of a unique American destiny. The seventeenth century Puritan distrust of the wilderness was supplemented by an affirmation of its role in shaping a national character that invited men to test their manhood in terms of obstacle and challenge. (8-46)

When the cultural landscape had evolved, and after it had been twice severely tested by the climate, the stage was set for the evolution of a new Great Plains culture. It would be based on the pride of being able to take it.

The Culture of the Great Plains

So far we have looked at the impact the settler had on the native landscape but it may be very interesting to know what impact the natural American landscape had upon the American and European settler. Vincent Scully writes:

> It is clear that the European in America never felt entirely fixed in place upon this continent. He had left the closed gardens of the European landscape behind him, and his new natural environment was larger, more hostile and above all less bounded than any he had known before. (14-15)

A very interesting eyewitness report of the evolution of a cultural landscape on the Plains is given by Nobel L. Prentis in his article, "A Day with the Mennonites." The Mennonites came to Topeka in 1874-1875 to look for homestead land. They secured excellent land from the Santa Fe company and soon moved to it. Mr. Prentis visited some of the settlers and observed:

> In 1875 the Mennonites were still a strange people. They retained the little green flaring wagons they had brought from Russia, and were attempting to live here under the same rule they followed in Russia. The village of Gnaudenau was the most pretentious of their villages. It was a long row of houses mostly built of sod and thatched with long prairie grass. A few of the wealthier citizens had built frame houses, furnished with the brick ovens of Russian origin which warm the family and cook its food for all day with two armfuls of loose straw.
>
> The land belonging in severalty to the villagers, lay around the settlement, some of it at a considerable distance, while near at hand was a large common field, or rather garden, which was principally devoted to watermelons, which seemed the principal article on the Mennonite bill of fare. (31-98)

Several years later the writer was able to return and take another look at the Mennonites:

> The wheat waved a varying shade of green, shifting in its lines like sea-water; the prairie chickens rose on whirring wing before the old hunting dog which ran before the carriage

> flocks of long billed plover looked out of the grass; and the meadow lark rehearsed a few notes of his never finished song.
>
> A great change had taken place in the country generally since my last visit. The then raw prairie was now, barring the fences, very like Illinois. (31-98)

The fact that the country looked like Illinois was undoubtedly due to the fact that during the period of eight consecutive years after 1877 the region enjoyed such a plentiful rainfall that many people believed its characteristic aridity had passed. On this second visit Mr. Prentis saw that the Mennonites had abandoned the village system and now lived "each man to himself," with this result:

> The most surprising thing about these places is the growth of the trees. I left bare prairie; I returned to find a score of miniature forests in sight from any point of view. The wheat and corn fields were unfenced, of course, but several acres around every house were set in hedges, orchards, lanes and alleys of trees--trees in lines, trees in groups and trees all alone. In many cases the houses were hardly visible from the road, and in a few years will be entirely hidden in the cool shade. Where the houses were only a few hundred yards apart, as was frequently the case, a path ran from one to the other, between two lines of poplars or cottonwoods. A very common shrub was imported from Russia and called the wild olive, the flowers being very fragrant, but the all prevailing growth was the mulberry another Russian idea, which is used as a hedge, a fruit tree, for fuel and food for the silk worm. (31-89)

In the shaping of their environment the Mennonites undoubtedly drew on earlier experience and a characteristic landscape as they had known it in Russia. Here is perhaps an expression of simple native talent which is only found in simple gardens. It is a true art which has grown out of the soil and heart of the people. It belongs, it fits, and if done well, is inherited from father to son, just like the English cottage garden which has traditionally been passed on from one generation to the next. The Mennonites had established a sense of place; they sent roots down to stay. A cultural landscape had evolved to which they belonged even with their strange green wagons.

The eight years with ample rainfall helped the settlers on the Plains to get started and encouraged them to plant trees and windbreaks around their homesteads and fields. But drier years would come back which would challenge the skills and stamina of the homesteaders. It would also challenge the idea of ownership and reenforce the need to "garden" the landscape.

Jackson dwelt on this possibility in his book, American Space:

> In the decade after the Civil War there could not have been many persons left to remember the early years of the Republic. They would have belonged to that fortunate generation which rediscovered and first celebrated the wonders of the still half wild landscape of America. Niagara Falls, the valley of the Hudson, the White Mountains, the North Forest had moved and inspired them all when they were young. Yet sometimes it had been as if they were strangers admiring alien works of art; neither history nor daily association had as yet had time to create a bond between them and the surrounding splendor, they did not yet belong together.
>
> If as Americans they speculated about the relationship it was to hope that the natural scenery would have an edifying effect on the people living in its midst.
>
> The younger generation saw the national environment in a different light. Perhaps they knew it better, for they had travelled more. Though they inherited without questioning their parents' belief in the superiority of America over all other nations, they had a belief of their own that the country belonged to them by right of conquest as well as by right of inheritance. It was theirs to do with as they pleased.
>
> Unlike their fathers they saw themselves not merely as inhabitants but as owners and with an owner instinct they sought to find out the value of the patrimony. (19-57)

A love for the garden is a vital factor in any culture. There are records of civilized Indian tribes in Mexico who loved their flowers and trees to the extent that they would fight for their protection. There are songs left to tell the story (3-90).

It is not through songs but through the arts that we can learn much about earlier landscapes, and the cultures people built in those landscapes. When we look at western paintings by men like George Catlin it will help us to know that most of his paintings were painted out of doors rather than in a studio. This practice was not at all common in Europe or the east. Catlin lived among the Indians and buffalo hunters, and got his inspiration out in the open. Most of the pictures are realistic as little effort was made to glorify what was already glorious to begin with. Throughout history artists have taught men different ways of seeing nature, just as writers have shown us various ways of thinking about it: "In essence art constitutes a kind of feedback system, a means whereby men send messages to themselves about the nature of reality" (8-18).

The landscape architect Jensen writes:

> The artist is a spiritual leader and his message grows in importance as he comprehends the world in which he lives. He may lead his people into a wholesome, a lifting and forward looking sphere. (20-23)

Frank Lloyd Wright called Jensen a "nature poet." Jensen's success in his many works was his ability to work with plant material and make natural compositions look as though they had been there for a long time. He was very conscious that any alteration of his planting plans would destroy his carefully developed concept.

Jensen thought of landscaping as an art closer to music than any other art: "Its rhythm and its tonal qualities are as a folk song or a sonata. In its greatness it might be a symphony" (11-90).

Dempsey expands on the art of landscape in his book An Introduction to Environmental Psychology:

> Much of our environment is not experienced directly but through interposed surrogate environments that act as representations of 'first' order reality. To cite an example, we cannot visit the Grand Canyon in person but we see a film about it; hear a lecture on it; read of spectacular beauty; study a topographical model of it in a museum or listen to a musical composition such as Grofe's Grand Canyon suite. (8-99)

Just as music can give us feeling for a landscape and partly can describe it, so can literature, especially poetry. The early literature is full of fear and hatred of the prairies. The pioneers dreaded the blizzards, the winter winds, the hot summer blasts that killed or ruined crops. But as has already been seen in this section, there were compensations, elements of beauty in the natural and cultural landscape.

The Swedish novelist Vilhelm Moberg has conveyed something of the wonderment of the Scandinavian settlers in Minnesota's St. Cross valley in the following lines:

> As autumn progressed, the leaves of the trees changed color, making the forest more beautiful than ever. There stood the red mountain ash, surrounded by brown walnut trees, the green aspens among the golden yellow lindens. The oak, the master tree of the forest, still kept its leaves green as did the aspen and the poplar. Here grew white oak, black oak, red oak, and now they could recognize the different types. The white oak grew in Sweden also, its leaves turned brown in the fall. The leaves of the other oaks now took on a dark red sheen resembling blossoms, the settlers said that it looked as though these oaks bloomed in autumn. (19-17)

Visually, the landscape painter can have the greatest impact on our senses because he can show us through his media what the landscape has been like and now is. Ralph Waldo Emerson wrote in his journal of October 13, 1837:

> Go out to walk with a painter and you shall see for the first time groups, colors, clouds and keepings, and shall have the pleasure of discovering resources in a hitherto barren ground, of finding as good as a new sense in such skill to use an old one.

The painter Alan Gussow wrote a book A Sense of Place to show us through paintings what will happen if through our mistaken ideas of progress, we continue our increasing use of American space and wilderness. Gussow says "the best defense against unending deprivation that must be the consequence of such unending demand is a revival of man's sense of place" (15-15).

When an artist paints a landscape, he or she is among other things attaching a value if not to the landscape, then to the experience which the landscape prompted. These artists are not illustrators and their works are not the products of tourist mentality. Poet Richard Wilbur in his introduction to the book says that three conditions must be met before an artist can paint a place, observation, the adaptation of technique and the discovery of what in himself the scenery might declare and this at last makes it possible for him to paint. It implies, Wilbur continues, no easy affinity, no facile personalization or imposition of mood but a struggle with something powerfully other. The best landscape painters also know the value of waiting. They know too when the scenery declares itself. Then they begin.

The key to the culture of the Great Plains is the sense of belonging to this place. In cultivating this "sense of place" the artist has the greatest effect on its inhabitants for he opens their eyes to the beauty they miss around them. Among these artists the landscaper is most important for he deals with the dynamic materials of plants. To realize fully the culture of the Great Plains, then, it is necessary for the landscaper to show how his special approach and activity can increase the "sense of place" among the citizens of the Great Plains.

CHAPTER IV

PRINCIPLES AND MATERIALS OF LANDSCAPE DESIGN IN THE GREAT PLAINS

Introduction

The landscaper of the Great Plains, like anyone who works in the field of landscaping, is aware of basic principles of design, but he must also be aware of the evolution of the natural and cultural landscapes of the Plains, as presented in the preceding chapters.

The basic principles of design are the same everywhere:

Proportion and scale: A pleasing relationship exists between the three dimensions of length, breadth and height, but in the Plains the plane dimensions outweigh the elevation.

Balance: Accents are carefully distributed over an area, without necessarily spacing them equally each side of an axis; the accents are likely to be sparse and scattered on the Plains.

Unity: The component parts, each being a pleasing feature, fit together to form an equally pleasing whole, but on the Plains unity is difficult to grasp because the horizontal boundaries are indeterminate.

Elegance of line and shape: Lines are designed so that they are pleasing; curves are not interrupted. The eye should be carried from one part to another fluently. When a designer wants to create or control patterns, he does so by making use of lines. These lines may be expressed through paths, rock walls, and fences, the last especially dominant on the Plains. In a landscape composition a carefully planned group of lines will direct the attention of the viewer to a particular area of interest. Lines are also useful in controlling movement. Straight lines suggest movement without hesitation; on the Plains the lines of the cultural landscape express this strongly. Interconnecting straight lines create points at the intersections for hesitation, as crossroads do on the Plains. Meandering, curved lines invite slower movement and are best used in areas that are as natural as possible, such as a nature path; the natural landscape of the Plains possesses this feature but it is contradicted by the prevalence of straight lines.

Contrast and harmony: Lines flowing harmoniously together are very pleasing to observe; on the other hand, bold contrast of a curve with a straight line can be very interesting, if done with care. When selecting plant material the contrast of fine foliage with coarser, rounded outlines with vertical or spiked growth, the harmony of blended flower and foliage color, and the sharp contrast of white flowers against red, or yellow against purple, are examples of contrast.

Emphasis: Through the use of emphasis the eye is directed to one portion or object of the composition. Secondary points of emphasis may be used where the eye is directed towards plants or other landscape features that have less contrast with the overall composition than the primary point or area of emphasis has. Vertical elevations on the Plains are obviously dramatic, more so than in other landscapes. Their emphasis value is very high.

Variety: A critical element in design is variety: too little leads to monotony which was experienced so often by early settlers and today is expressed by many travelers crossing the Plains. A very fine balance between extremes produces a pleasant sense of unity in a landscape composition, but both the natural and the cultural landscapes of the Plains seem to defeat the landscaper's intent on variety.

Repetition: Repetition gives the element of variety meaning and expression. A variety of lines, forms, textures, and colors is needed to create an interesting landscape, but this does not mean that every shrub and every tree must be different within a design. Repetition is usually achieved by placing individual plants in groups or masses of a single species. In a large scale landscape these masses of varying sizes may be repeated.

Obviously the basic principles of design, as established in the east and in Europe, have to be specially modified when applied on the Great Plains. The first problem of the landscaper, like that of the first settlers, is to adapt these principles to the environment. The same is true when considering the use of plant material, with its three important design qualities: form, texture, and color.

Form: A composition will be more attractive when plants are used that are natural looking and graceful when they are fully grown. The trunk, branches, and leaves together create the form of a tree. The different plant forms we recognize are: columnar, round, vase, weeping, pyramidal, and oval, but not all of these will work on the Plains. Generally speaking, if the plant is tall it is said to have a vertical form. If it is low and spreading it has a horizontal form. When a group of vertical plant forms are placed together in large enough number so that the length of the group is greater than the height, then the mass of plants has a horizontal form, as in a windbreak, which is very suitable for use on the Plains to establish a relationship in the natural landscape between plant forms and topography; the basic form of the topography is repeated in the native plant materials. On the Great Plains the flattened windswept horizontal form can be seen in plants. The round low ground-hugging plant forms can be seen on the rolling prairie. Such forms should be adhered to and predominantly used in local landscape plantings; this is one of the basic principles useful to the landscaper of the Plains.

Texture: Texture is a plant's quality of coarseness or fineness of appearance. Seen close up, texture is shown by the size, surface and spacing of leaves and twigs at different seasons. At a distance texture is the entire mass effect of plants and the quality of light and shadow. The patterns created by light and shade are an important part of texture. The gradation of texture in plants is expressed from fine to medium to coarse. Too much texture uniformity results in monotony; contrast can be obtained through variations, but extremes should be avoided. Texture is more of a problem than form on the Plains because the textures change with each season and indeed with each hour of the day.

Color: Color in the landscape is a very important factor. The Great Plains do not have the abundance of fall color as seen in our deciduous northern woods; the colors are more subdued, but do change with the seasons. In general, reds, orange and yellows are considered warm colors and seem to advance toward the viewer. Greens and blues seem to recede in a composition. Dark blue, a cool color, would be suitable as a background color to increase the feeling of depth. Gray is a neutral color and is best used in the background when bright colors are used in the foreground. The palette of the Plains landscaper has more choices than might be thought but the initial problem is the apparent lack of color in the landscape. The color we see in the landscape, however, is affected by the reflective values of the surfaces, by the quality of light, by the color reflections of adjacent objects, and by shadows. And the play of light in the Plains adds considerably to the range of color available to the landscaper.

A harmonious color design is most easily obtained by providing a dominance in one color. Colors of all the aspects of the composition should be considered--plant materials and their changes as well as structures.

> The effect of simultaneous contrast suggests that fences, pavements and building should have a neutral color of low value and intensity that will make them appear smaller and farther away. Then the plants and resulting space become dominant in the composition. You must decide which elements will be dominant and which will be subordinate in each landscape that you develop. If each element had equal importance, the result is visual chaos. Conversely, if every element is subordinate, the result is monotony. It is planned contrast between the two extremes that gives a "spark" to design. (28-84)

Obviously, designing a landscape on the Plains to avoid either chaos or monotony is a great challenge.

Where many of the arts move in the realm of three dimensions, landscape design has a fourth, namely time. The element of time is more important than the other three because the material is never static; plants take time to grow, and in time die. The lifespan of trees is often longer than that of man and in many instances longer than the buildings created today; trees mark the presence of dead homesteads. Trees grouped together develop in time a character. Trees exposed to wind will grow differently from those given shelter. Our ultimate conception of our composition, as far as it depends on trees, may take up to fifty years to mature. Sometimes it is possible to reduce planning to an almost three-dimensional problem by using already well developed trees and shrubs with the help of mechanical methods. Although the use of large semi-mature plants may have its advantages, the ultimate results are not the same as and are less satisfactory than traditional methods, particularly in the case of shelter planting.

> The pleasure of watching things develop in time, and of noting and enjoying each different phase as it appears, is not to be relinquished lightly--to miss out these intermediate stages is to loose one of those contacts with the soil which our period can ill afford; and the artificial completion of the project at one stroke is one of those means by which civilization impoverishes the realities of living in time. (12-127)

Vegetation, one of the essential components of landscape, is thus an everchanging material. Another material is land. Each in a different way contributes to those solid masses and open spaces which make up a landscape composition. In the case of the Plains, the hills and convex forms make up the masses, while the valleys, plains and water surfaces form the voids. Vegetation provides masses in the form of groups of trees and shrubs (taller than man) and voids of turf, low plants, and farm crops which his eye can dominate (12-116). The interplay of the four themes, land and plant forms, masses and voids, depends on existing contours, basic indications of climate, soil type, and land use, all providing variety in the landscape. In nature, or in agricultural landscape produced with understanding of land use, there exists a harmonious relationship between land forms and vegetation resulting from underlying facts of ecology and geology (12-117).

The two remaining landscape elements are water and structures. Water contained in reservoirs and farm ponds or flowing through a river can be a very attractive addition to the landscape. When reservoirs or dams are built they present a better landscape when designed with an eye to the ground forms of the land below the dam, and sited off all areas affected by roads, and when other new structures are shaped to flow into existing contours, rather than made into the uniform slopes and rigid lines as is so often seen. The new forms should be designed into the surrounding landscape pattern.

Today many landscapes have to absorb industrial building complexes and power stations, many of them sited in open country. Often, their effect depends upon the shape of the structure in relation to the ground form. The role of plants, if any, in the majority of industrial sites is to serve as a screen for the clutter that has accumulated on the ground around the buildings. Where high chimneys and towers are part of the complex, massed planting of trees or shrubs can give strong horizontal base lines which help balance the height of structures. Such grouping of plant materials should be undisturbed by parked cars, sheds, and other clutter which tends to destroy the intended simplicity of design. Where trees will not grow, a good relationship between structure and ground form can be achieved by modeling the land and shaping the contours to screen clutter where necessary.

> Factories and other industrial buildings dominate their sites and occupy a large proportion of their land, but nearly all have open space or non-operational land within their boundaries which provides their landscape setting: such space can be used to relate the buildings and installations to their surroundings. That this is best done by means of trees, shrubs and grass with suitable ground modelling, rather than by a blaze of seasonal bedded-out plants, has yet to be fully appreciated by many concerns. (7-346)

Large open spaces around buildings should be grazed rather than mown. The livestock adds another dimension, and in a rural area they fit the land use pattern.

We need to pay attention to the style of new structures, but even more should be paid to some of our older structures which help to give the rural landscape character, in particular our farm buildings. Eric Sloane writes:

> When costly structures built less than fifty years ago have become obsolete and are being torn down, it is amazing and significant that a simple barn in the country, even in a state of ruin, can continue to benefit and enrich its surroundings after two centuries. And when that barn is threatened by a new housing development, it is usually the old barn that seems attractive, while the new buildings look grotesque--until, of course the old barn is removed and we can become accustomed to the sameness of mediocre design. (39-13)

Sloane refers to old barns as buildings in a state of pleasing decay. We should look three times at such a building before we decide to remove it; firstly, to see if it has no virtues in itself for which it will be missed; secondly, to see if it will not be missed as an enrichment of its present surroundings; and thirdly, to determine if it might not be used as an useful point of focus in its future surroundings (39-13).

While the basic principles of design are the same everywhere, few of them can be applied to the landscape of the Plains as easily as in rolling, wooded, watered country with a long history of farm occupation and buildings. The remainder of this chapter considers the special problems of the landscaper of the Plains, especially in using plant material.

Native Plant Materials of the Great Plains

The ecology of the natural Plains landscape is one of give and take along the eastern boundaries where the tall grasses competed with the trees for ground and were often assisted by fire which was beneficial to grass but not to trees. Furthermore, along their fringes the buffalo tramped small trees down. On the other hand, the overgrazing by buffalo encouraged prairie conditions along the eastern fringe of the Plains. The grass cover had both an ally and an enemy in the buffalo. The ecology was balanced, in this and other respects.

Originally the prairies were covered with tall grasses in the east and short grasses in the west. Mixed in with the grasses were wild flowers. Trees were rare except among the "oak openings" on the eastern boundary, and along the stream valleys where there was ample moisture to support trees.

Further west in the Plains where the shorter grasses dominated the prairie; the scene could change according to the climatic changes: with periods of above average rainfall tall grasses flourished; when droughts struck, grasses withered but survived because of deep root systems, or other survival methods. The tall grasses are able to move into the short grass ranges along the low lands where and when moisture is more abundant.

In a study on the relative importance of the 10 grasses which compose approximately 95 percent of the grass population (Weaver and Fitzpatric, 1932), lowland grasses were identified as big bluestem (Andropogon gerardi), Indian grass (Sorghastrum nutans), prairie cordgrass (Spartina pectinata), switch grass (Panicum virgatum) and Canada wild-rye (Elymus canadensis). Upland grasses were the little bluestem (Andropogon scoparius), needlegrass (Stipa spartea), prairie dropseed (Sporobolus heterolepsis), side-oats grama (Bouteloua curtipendula) and June grass (Koeleria cristata) (47-33).

The grasses of the western Plains are the drought resistant short grasses such as grama and buffalo grass. These grasses can enter a rest stage during drought and produce seed in a very short time after moisture becomes available.

On low hillsides, and everywhere on low lands, big bluestem is the most important dominant of well-aerated soils. In saturated soils, big bluestem gives way to vast areas of prairie cordgrass. In soils of intermediate water content and aeration, switch grass is the main species. The two bluestems are the most important dominants of the prairie; together they make up more than 70 percent or more of the vegetation.

Seedlings of big bluestem develop rapidly and in the absence of competition, clumps 12 to 18 feet tall may occur at the end of a single growing season. In low land, sod roots from stem bases and rhyzomes have a vertically downward course but on upland among the bunch grasses roots spread widely in surface inches of the soil. Little bluestem, a bunch grass which forms the great cover of the uplands, exceeds all of the other upland species combined.

With a climate as described in a previous section it is not difficult to understand that extra care should be given to the selection and use of plant material to create a functional landscape. A good example of the creation of a functional landscape was the establishment of shelterbelts on the Great Plains to stop wind erosion, and around homesteads to make the living environment more pleasurable and comfortable. Especially along the western fringe of the Great Plains care had to be taken as to which plant material to select to assure the greatest success over a long period of time.

Although the area is predominantly prairie, woody plants cover a great deal of it, far more than most people have been led to believe. It is true many of the species within the region are at the extreme edge of their range and the bordering floristic provinces have had a great influence on the vegetation of the Great Plains. But H. A. Stephens in his book Woody Plants of the North Central Plains (1973) describes more than 500 woody plants which are found more or less abundantly on the North Central Plains.

Lack of moisture has the greatest effect on forest expansion. Extremely low winter temperatures tend to reduce the number of seedlings, due to soil heaving as well as to winter killing resulting from drought in the frozen soil. Wind has considerable influence on forest and tree development. The hot dry south winds blowing during summer time lower the humidity. There is a higher rate of water loss in the prairie than in the shrub and forest covered areas. Light is a factor used by forest to encroach on the prairie during favorable climatic periods. In the tension zone between woodland and the prairie, the shading of grasses by shrubs is one of the outstanding features of the invasion of the grassland. Grass and sumac disappear before the invading hazelnut.

Many a landscape which is not strongly characterized by any ground form takes a notable character from the vegetation which grows upon it. Such a character will be found repeatedly when similar soil and climate conditions make similar vegetation possible. This repetition of vegetation in a vast landscape, such as the Plains does give a very subtle beauty which may be difficult to explain in terms of the basic principles of design in the preceding section. Nevertheless, unless the Plains landscaper can appreciate this factor, he is lost before he starts.

It is easily demonstrated that the Great Plains contain few plants of significant importance that are not also native to the East. But nature is extravagant with certain plants in the Middle West, such as cottonwoods and oaks, especially the burr oak, windswept hawthorns and native crabapples, prairie rose, wild blue phlox, purple cornflowers, sunflowers, violets and many others. The result has been a landscape very different from one dominated by pines or spruces, and masses of deciduous trees or palms.

The red cedar which turns into a characteristic brown in the winter, blends well into the Plains landscape with its predominant dry brown grass color. The red cedars grow in groves often seen on drier hillsides. The Austrian pine, though well adapted and of somewhat similar pyramidal form, holds too green a color during the winter months to blend in the native landscape. (This point will be discussed later.)

In early days when there were no nurseries and few railroads for transportation, the first homesteads used solely native plant materials, often saplings taken from the woods or stream banks. Such planted trees expressed the local color of the region and tied a home or community to the area. The result was a homogeneous landscape, and some of the finest examples of rural landscaping. A good example is the landscape created by the early Mennonites who settled the Plains in McPherson county in Kansas.

If prairie plants are used with understanding of the processes of nature, the species possesses the innate horticultural fitness to climate soil and topography. When associated into the proper groups they become so harmonious in form, texture and color so that it seems as if the plantings might have been only one large plant. Yet on a closer look, one is aware of the colorful individuality of the various species making up the composition. By selecting and planting species that will best grow on the particular spot landscaping reaches its highest level.

Quite often people have little interest in using native plants, and the remark is made that native plants are coarse, to which Jensen replied:

> If however, as is said our native landscape is coarse, then as time goes by we, the American people, shall also become coarse because we shall be molded into our environment. (11-172)

Obviously coarseness is in the eye of the beholder.

Jens Jensen was a master in understanding native plant material and landscaping with it for the benefit of the people, choosing his plant material with careful attention to both horticultural fitness and esthetic purpose as in this example:

> Since the land was generally low and well drained for most of the hard woods were included. The large trees are there for elm, linden, ash, and cherry, with a few sugar maples, oaks where soils were favorable.
>
> For similar reasons the border plantings were mostly crab apple, hawthorn, plum, sheepberry, ninebark and dogwood.
>
> In the low places witchhazel and a few prairie roses were used.
>
> Undergrowth among trees was provided by gray dogwood, witchhazel, sheepberry and viburnum.
>
> On the waterfront, elderberry, bladdernut and yellow currant were added. Groups of crabapples and hawthorn together with sumac extended on to the lawns to break monotony of the long border.
>
> Finally prairie flowers such as asters, golden rod, cornflowers, phlox and shooting stars were introduced in open places bordering the meadow and as undergrowth Jacobs ladder, violets, spring beauties, trilium and anemones. (11-40)

Jens Jensen was not alone in his enthusiasm for using native plant material. Frederick Law Olmstead, Sr. had done the same.

The way to learn how to use native plant species is to observe them in their natural composition in the natural landscape. That is one reason why the conservation of our natural landscape is important, not only to us but also to generations to come, so they too can understand and learn to create attractive landscapes with the native plant material by studying it in its native habitat.

This provision for the future is necessary because many of Jens Jensen's landscape works have been destroyed by the expansion of towns and cities. But his philosophy allowed for that. He once said, "It does not matter to the landscape architecture's future that many of my works are destroyed, because each generation should have the privilege to find the solution for itself. My works should not be copies; they should be understood." Once the landscaping done by Jensen is understood, the art of organizing large open spaces, miniature prairies, set off by native plant material is not difficult to realize. Most important is to accept the need for the conservation of natural landscapes of the Great Plains.

Conservation of Natural Landscape in the Great Plains

Jens Jensen wrote in his book Siftings:

> Untold motives and ideas are revealed to me in the out of doors, not to be copied, because man cannot copy nature, but from which to develop a folksong or a poem. The art of landscaping like all other arts, is that of a fleeting thought that must be caught on the wing. (20-42)

When an area of the earth's surface is felt to be esthetically unified because of a naturally produced harmony among the many parts which form that landscape, one can say that the landscape has character. In the Germanic language the original use of the word landscape indicated a region or a province. In time the word landscape came to be associated with the image of the land of that region, denoting its character.

Landscape character, when natural, is the result of the forces of nature not guided by man. When the esthetic organization of a landscape is as near perfect as can be, it is because either nature or man--or both--is using the basic principles of design to create a real source of beauty. To see it, and especially to understand it, or to explain it often requires a more highly developed esthetic sensitiveness, and a great keenness of perception. This is because its organization very likely is more complicated and less obvious than that of many man-made objects; in their case we generally speak of a style.

Many people who cross the Great Plains by car think of that long drive as a most boring experience. But Jensen reflected on such a trip during a train ride:

> I watched the miles and miles of flat Nebraska prairies come into view. My fellow passengers expressed themselves as being bored with the monotony of these vast plains which had neither a tree nor an elevation to break their bleakness. They seemed to be an "unending nothingness" as one passenger expressed. But as I sat watching, I gradually began to feel a great force arise from these flatlands, and I knew that here lay something far deeper, far more powerful than anything I had experienced before in the great out of doors. (20-108)

Jensen explains that to the passerby these prairies seemed devoid of all life. Just as growth, the silent force of continuous persistence, seems monotonous to our desire for the novel and the glittering.

> Out on the plains man comes face to face with life's immensity. Nothing is hidden; and when immensity is faced it loses all threat of swallowing man up for then he too becomes immense in understanding and he beckons to his brother across the plains that all is well. (20-109)

Indeed, the natural landscape of the Plains has an effect on us. All landscapes arouse in us certain emotions, such as peaceful, majestic, or boring, and when absorbed by the landscape we experience it in a kind of personification, although the effect of landscape in many cases is very subtle and can be very complicated, being difficult to define.

In Captain Butler's words the prairie personality and character is defined as:

> The unending vision of sky and grass, the dim, distant, and evershifting horizon; the ridges that seem to be rolled upon one another in motionless torpor; the effect of sunrise and sunset, of night narrowing the vision to nothing and morning only expanding it to a shapeless blank; a sigh and sign of a breeze that seems an echo in vision with the solitude of which it is the sole voice; and above all, the sense of lonely, unending distance which comes to the voyager when day after day has gone by, night has closed and morning dawned upon his onward progress under the same evermoving horizon of grass and sky. (5-50)

Henry Hubbard in his book An Introduction to the Study of Landscape Design (1929) predicts that in many places man's activities will eventually mask the character of the prairie. He raises the question whether the owners of the soil will ever go so far as to sacrifice many square miles of valuable prairie land merely for the preservation of a landscape effect:

> One thing is certain, at any rate: not by preserving its flora alone, but only by preserving its expanse can the spirit of the prairie be preserved. (18-63)

The feeling of a sense of place derives from a sense of the personality or character of that place. The place can never be removed but its character can be radically altered. Harvey G. Cox (1967) in his book On Not Leaving it to the Snake, tells about the incident during the second world war when as a reprisal, the small village of Lidice in Czechoslovakia was entirely obliterated. The village was burned, all trees and foliage destroyed and the ground was plowed up. Lidice no longer existed. The name Lidice was removed from all school maps to complete the destruction. When Cox spoke later with one of the women survivors she confessed that despite the loss of her husband and the long separation from her children, the most shocking blow of all was to return at the end of the war to the crest of the hill overlooking Lidice and to find nothing there, not even ruins.

Later in life Jens Jensen established "The Clearing." When he was 24 years old he left Denmark, a country where every foot of space was planned and cultivated; there was no such thing as a list of virgin forest and prairies. He found in North America the buffalo still roamed the western plains and the white pine of Northern Wisconsin was still there. The prairies were still limitless.

Jensen saw the pattern change within 25 years and he realized what was going to happen. He predicted one large city all the way from Gary, Indiana, to Milwaukee, Wisconsin, and dreamed of how he could save the landscape and make good landscape available to man. Out of this dream came the "Clearing." The location was chosen in Door County, Wisconsin. To find the right place Jensen had sent two of his assistants from his studio in Ravinia. One went east and the other skirted the Great Lakes area. He told them to look for a place where rural life bordered on the wilderness. He said the area must be an outpost facing the setting sun for here was the hope of tomorrow, and he added that the area must be on rock and not on moving sand.

He selected Door County after hearing one of the reports and went to Ellison Bay to search for just the right place. He found it when he followed a road until it came to a meadow, filled with flowers, with a little orchard at one end, and a stone wall--all suggestive of a pioneer hand that had come and gone leaving these evidences of life. From the meadow the road became a foot path up the hill and on to the bluffs. When he reached the bluff, he saw the blue waters of Green Bay stretching out as far as the eye could see, and to the left Ellison Bay, with the Bay bluffs beyond.

He started to build the Clearing when he was 75 years old. It was to be a school principally for young men studying landscape architecture. They would learn by doing and they would have the benefit of contact with people native to the area and with visitors from the outside. Some of those visitors were leaders in the arts: Carl Milles, the Swedish sculptor, Frank Lloyd Wright, Eliel Saarinen.

Jensen wanted to show the naturally produced harmony among the many parts which form a natural landscape, and help people to see that such a landscape has character--a character which can be used as a guide to develop a harmonious cultural landscape:

> The purpose of the school he declared was to disseminate the message of the great out of doors in its various moods as a fundamental principle to all arts and clear thinking. (11-216)

Importance of Natural Landscape in Relation to Land Use--Great Plains

The lack of importance given to the natural landscape of the Great Plains can perhaps best be sensed by the fact that there are no scenic parkways or scenic rivers as part of the National Park Service system, and there are very few national parks in the region of the Great Plains. Neither are there many state parks which depict the Plains natural scenery. The emphasis is on the cultural landscape, on the restoration of the military forts and the preservation of their history. Fort Larned is a national historic site in Kansas. Fort Lincoln in North Dakota is a state park because it is the fort from which Lieutenant Colonel Custer rode for Montana,but was stopped on the bluffs above the Little Big Horn by a successful military operation under the command of Chiefs Crow King, Sitting Bull and Crazy Horse. In the far southwest corner of Kansas is Cimarron National Grasslands. It borders the Cimarron river; part of it is the butte on which, supposedly, the Spanish explorer Coronado stood in his search for the cities of gold in the sixteenth century.

But most state parks have been located in an area where there are some outstanding natural phenomena. The Custer State Park in South Dakota is an integral part of the Black Hills region. The park consists of 72,000 acres in the heart of the Black Hills and has a scenic highway leading the visitors through switchback and tunnel among the amazing needles that show the granite core of the Black Hills. Chadron State Park in Nebraska is an area where the change of the low plains to the high plains is very noticeable. The visitor can reach a point 4,350 feet above sea level. Here are deeply dissected formations with their towering buttes and dark ravines, part of the Pine Ridge country of West Nebraska.

Freeman Tilden, in his book The State Parks and Their Meaning in American Life, remarks:

> Grasses are not thought of as scenic. Yet not the least important part of old-time Nebraska--the Nebraska of the

> plains Indian and before him a more primitive resident--which is preserved here are the communities of buffalo grass, blue gramma, big bluestem and the other low herbs that grow in this kind of land. Besides, the meadow lark, the horned lark and the lark bunting and the lark sparrow chose these grassy domains as their nesting grounds; and they still do. (45-272)

Although the Kansas Senate passed a resolution April 10, 1975, opposing the establishment of a Tallgrass Prairie National Park in the Kansas Flint Hills the issue is not settled. A group of people called "Save the Tallgrass Prairie" vowed "we'll not stop trying until we get a park." An amendment stated that if congress finds a need for a tall grass park it should establish a Prairie National Parkway through the Kansas Flint Hills. The plan is for a 60,000 acre tall grass park so that the area is large enough to keep large animals such as buffalo and elk biologically healthy by minimizing inter-breeding in the herds.

The unique state parks with their rather atypical landscape for the whole Plains region,are tourist attractions but it is the grasslands which would show the character of the landscape as experienced by most people. The ability to appreciate the beauty of free landscape can be developed by a study of landscape forms. This would lead to a better understanding of our Plains landscape and allow us to see subtler relationships which without study might go unseen, and this idea is no novelty. N. S. Shaler wrote in The Atlantic Monthly, December, 1898, in terms that seem to apply more to the Plains than any other region of the United States:

> It is evident that our culture is near the station where we may hope for some effort to develop the landscape sense by a systematic training in the arts which may enable us to appreciate scenery with the advance which an assiduous training of the landscape sense brings, the observer finds himself

> less in need of the human note in the view, his development follows the course by which the landscape motive becomes established.
>
> From the limited though varied aspects of the over-humanized view in and about the town, the student should pass, in a well-devised gradation, to the scenes where pure nature, though the fields be tilled, controls the expression, and thence by a further step to the primitive lands where there is no trace of the hand of man. As he departs from the realm of excessive culture, where the expression of the earth everywhere is controlled by the artificial, the need increases of an enlargement of the conception by the understanding of how the natural forces have shaped the view.
>
> If as seems likely, we can bring into definite shape, by educative men as, the emotions which lead to pleasure in the landscape, we shall thereby add another important art to those which serve to dignify our lives. The art of seeing the landscape has a certain advantage over all, the others we have invented, in that the data it uses are ever before those who are blessed with eyes. Outside of prison, a man is sure of the sky--the largest, most varied, and in some regards the richest element of all scenes. The earth about him may be defiled, but rarely in such measure that it will not yield him good fruit. Every look abroad tempts him beyond himself into an enlarging contact with nature. Not only are the opportunities for this art ever soliciting the mind, but the practice of it demands no long painful novitiate. There is much satisfaction at the very beginning of the practice; it grows with exercise, until it opens the world as no other art can do. (18-13)

Jens Jensen stressed the need of appreciation of the natural landscape over and over again:

> We shall never produce an art of landscaping worthwhile until we have learned to love the soil and the beauty of our homeland, and to fit man's accomplishments into its infinite harmony. To separate ourselves from this means degeneration. (20-92)

Nature is not to be copied but the importance of the natural landscape is to give us the opportunity to observe, to interpret its message and to create our own compositions of plant material which belong in our cultural landscape. We can observe that nature seldom fails in scale. The natural landscape is always in harmony with the environment. People who must make landscaping decisions, and who have little or no background in this field, would do well to study the natural landscape in the area to get a feel for the problem and have a basis from which to start, as this thesis has continually suggested.

Knowledge of natural forms is a prerequisite to good landscape design on the Plains. Such knowledge can be obtained by patient study of the landscape form. The three fundamental forms are the convex, the concave, and the plane. The natural forms which these designate are the hills and mountains, the valleys, and the plains. When landscaping one works with similar forms but makes different form relationships on an often reduced scale, allowing only partial reproduction of the real thing. This is where the interpretation of the real is so important as a guide, as the following instances indicate.

When we look at hills on the Great Plains one of the very striking forms is the butte. These hills rise abruptly from the surrounding landscape, and have a more or less level area on top. The side slopes are generally steep. There is generally no connection of the outlines of the butte with the surrounding landscape except when they are found at the end of a ridge protruding in a valley. Then the backbone gives a feeling of position or placement in the overall composition. With the often steeply eroded sides or front, the layered construction of the butte can often be clearly seen. And, although the lines of these layers are abruptly cut off, and do not continue in an easy flow contour they can often be picked up on a similar hill or butte on the opposite side of the eroded valley. These hills belong to the landscape in their unique form, mass, and color.

The expression of natural forces will tend to repeat similar forms in any particular locality, obeying the design principle of repetition. The composition of hills and their valleys is unified by the repeated parallelism of lines of strata, and by the repeated step-like outlines which erosion has carved. The constant angle of eroded material deposited on a prominent slant may cause frequent repetition of a certain line of slope. The result is a parallelism of hillside against hillside often on opposite sides of a stream.

One of the first influences of man on the Great Plains landscape was the construction of roads. The relatively flat plains allowed the enforcement of the grid system, forcing the early roads to go straight north-east--south-west. The early engineers destroyed the pleasure many of the roads could have given because the roads often have a harsh effect on the land where there is some clear alternative expression of topography. The opportunity for enjoying changing contours of the land has been destroyed. Newer highways have been designed better but some gross mistakes have been made from the esthetic standpoint.

> Straight lines are copied from the architect and do not belong to the landscaper. They have nothing to do with nature of which landscaping is a part and out of which the art has grown. Landscaping must follow the lines of a free growing tree with its many curves. (20-42)

As an architect Frank Lloyd Wright found inspiration for his design on the wide open prairie. Wright built around 1900-1910 a style of home in the suburbs of Chicago in which he put the character of the open plains--free flow. He built homes in which the interior space was not compartmentalized but indeed flowed freely throughout the house. He called them prairie houses, arguing that their long low horizontal lines were a reflection of the natural lines of the midwestern landscape (11-15).

Inspiration for other arts can be achieved from a natural landscape, clearly stressing the importance of native landscape conservation not only for the landscape architect and those who seek his guidance but for other aspects of man's life as well. Each type of landscape has a spirit of its own. A person born and grown up on the Plains and later having moved to the mountains or city generally longs for the vast open spaces where the horizon seems to touch the earth. Many prairie people drive great distances or fly overseas summer after summer to see new grandiose landscapes. If they only could learn to see the landscapes closer to their home they could be satisfied; repeated exposure to a particular landscape reinforces the love for it. I know a gentleman who for twenty-five years, a few times a week walked with his dogs for one hour along the same terrain. It never is the same to him; each time it is new although it is a familiar experience, because of changing seasons.

In recent years a specific study of this phenomenon has evolved in the concept of behavioral orientation in the field of geography. One of the major questions is how the terrain and other geographical factors influences the behavior and experiences of people. Also the reverse is looked at. How does man influence his geographical setting? Apparently there has been much talk but little development toward conceptualizing an approach to the physical environment (8-74). In effect we are dealing here with the psychology of landscape. This is the last and most important argument for the preservation of the natural landscape of the Plains. If, as has been said, the Plains have a character or personality easily felt but defined with difficulty, then that personality has behind it a psychology. We have seen that misunderstanding of the essentially desert heat of the Plains produced human catastrophe in the thirties. Further study of the psychology of the natural landscape could prevent a repetition of that.

There is no question that the change from a natural landscape to a cultural landscape on the Great Plains came about through much hardship and that little time was devoted to explore or to expound a theory of the real nature of the Great Plains landscape. Neither was the need recognized to set parts aside for future generations so they might understand that landscape better. Many of the early and even later settlers wondered why they ever came.

Mari Sandoz in "Old Jules," quotes a bitter piece of rhyming carved into the door of a deserted house on those dry lands that rebelled against the plow:

> 30 miles to water
> 20 miles to wood
> 10 miles to hell
> And I gone there for good (34-213)

Yet in a little over one hundred years a landscape evolved on the Great Plains which was created by man. It was different than known in the east, for a new agriculture developed which resulted in a new cultural landscape. By trying to understand how it evolved (as suggested in Chapter III) we will be able to conserve today's cultural landscape more effectively for ourselves and generations to come.

Conservation of the Cultural Landscape--Great Plains

The term "cultural landscape" as used here does not mean landscape architecture which is practiced on relatively small areas of land. For the Great Plains cultural landscape must mean the originally natural landscape modified by man into a rural landscape over a period of time. Being able to appreciate the slow alteration over that period of time means being able to see the rural landscape as cultural landscape (46-1).

Four features make up a cultural landscape.

1. It satisfies the subjective need for a harmonious relationship between man and the land.
2. It is historically man-made over a period of time.
3. It is highly functional.
4. It distinguishes individual regional characteristics.

An attractive cultural landscape is one which balances successfully these four criteria. Firstly, man must respond to the landscape positively; a person should feel attracted enough to want to stop and rest. Secondly, it should contain historical evidence of man's manipulation of the lines of the landscape but not their obliteration. Thirdly, the landscape should be functional. The manipulation of man must be intended to produce a product such as wheat or beef, or a bridge to cross a stream, or a barn or anything else, but it must have function. And fourthly, it must be possible to preserve the cultural landscape intact.

A cultural landscape becomes potentially attractive when it is out of balance, but can be restored relatively easily.

A cultural landscape becomes unattractive when it is out of balance and restoration is very difficult and very costly.

The observed environment is not necessarily the real environment; what we see and what exists may be quite different. This explains why two people rarely experience a landscape in exactly the same way. Someone who happens to drive through the Great Plains may call the landscape monotonous, whereas the native may experience it as a kind of wholesome simplicity. Both concentrate on one aspect which is its reassuring sameness. How we experience a particular landscape depends on our ethnic background and often on our mood.

> The pleasure caused by any work of art will be different in the mind of each beholder as the mind of each beholder is different. The designer can be sure of his effect only insofar as he can know the mass of memories to which his design must appeal. There are some experiences which are the common lot of all mankind throughout the ages, and works of art which appeal to the memories of these will appeal to every man and will live as long as these memories remain the common property of man. (18-15)

Another term for these "memories" is the basic principles of design used in the first section. On the other hand

> Works of art which depend for their interest on knowledge or desire born of a transitory period will die with the desires which brought them into being. In the same way a work of art designed for an individual owner, without regard to the common memories and training of mankind at large, is apt to please no one but the owner and will probably not please him for long. (18-15)

If we consider the above in relation to our cultural landscape we can see the applicability of the former and the warning of the latter for the Great Plains. All environments carry a set of meanings acquired through their special social, cultural or economic attributes. They are understood by the individual in terms of his own perceptions and values; we may admire a field of wheat for its beauty but we know that its purpose is to produce food. Besides having this clear function, it may stand as a source or power and especially prestige to the owner. This is a latent meaning. If the land is farmed progressively and with modern methods, it can be said to symbolize the new agriculture. These environmental meanings, esthetic, utilitarian, latent and symbolic are all responded to in some degree by a good observer.

A little over a hundred years ago there was an active search in America for new and better rural societies. George Waring, Jr. was one of the advocates of a revitalized rural landscape. His main concern was how to bring some element of sociability and relaxation to the average Eastern farmer who in the course of recent agricultural changes had lost contact with the community. Waring suggested fox hunting to relieve the lonely monotony of their life!

In 1875 he outlined a plan for creating farm villages or small centers of community life throughout the United States. For the rectilinear west and midwest he proposed that every township, an area of 36 square miles, be divided into nine settlements in each of which there was to be a small compact village of some 300 people living around a small common with a church, a school, a store and a "public house." The farm lands were to extend back of the dwellings. A tree lined street with those anemities would in time foster community life.

He saw two merits in his plan: First, the farmers and their families would enjoy easy sociability with their neighbors. Secondly, the farmers would be able at the end of the day to leave the scene of their labors, something which every other working American could do.

The scheme, he remarked, promised what seems the easiest if not the only relief from the dullness and desolation of living which made American farming loathsome in 1875 to many who ought to glory in its pursuit (19-32). It is interesting to note that today this is a way of life for many farm families; the car and an improved road system have made this idea rather easy to implement.

The trend to larger farms is, of course, a later trend. As mentioned earlier, the explorer Powell suggested that every rancher and farmer should have at least 2560 acres or four square miles, most of which would be part of community pasture land. Powell rejected the traditional 160 acre farm for the west and the rectilinear survey as well. Holdings according to him should be defined by the physical characteristics of the land, by the availability of water and range.

The effect of a landscape of fields all conforming to the topography of the land, none of them rigidly confined within straight lines, interested other people as an improvement over the system of rectangular division. A landscape architect suggested to the readers of a rural magazine that farms be laid out in an ornamental fashion. He suggested fields of an irregular shape, bounded by hedges or rows of trees with gently curving carriage roads leading to the house and its neighboring barn (19-29).

But the farm had to evolve in its own way without benefit or advice from landscape architects. Lately landscape architects have become involved with homestead landscaping and, although the emphasis is on the home and its immediate surroundings, it is a good place to start teaching landscape appreciation and applying the principles that create or maintain a cultural landscape.

A broad approach to landscaping is being applied in the Netherlands, especially in the claimed areas from the sea, land which has been made cultural through the very active input of landscape planners in close cooperation with specialists of other fields. Not only has attention been given to the new homesteads but the whole polder landscape has been humanized through careful layout and setting aside areas for trees and shrubs. These might be set in groups or along rural roads or planted as single specimens at unique locations. The esthetic landscape in its largest form was the aim but the result achieved a very functional landscape as well.

> In the Netherlands, especially, the newly arrived forester may well think that this crowded country, with an average of more than 1,000 persons on a square mile, will have nothing to show in forestry. Quite the opposite. In the reclaimed lands, naturally devoid of trees, people go to considerable expense to provide trees as an addition to the landscape. On the lands being wrested from the Zuider Zee at a cost of nearly 1,500 dollars an acre, the Dutch are setting aside some 7.5 to 10 percent for afforestation.
>
> The planting on these new lands is not planned in the Netherlands primarily for the production of marketable products, even though the country is largely dependent on overseas sources for lumber and wood products.
>
> Dutch planning for their new agricultural lands also includes the establishment of tree plantings on farmsteads. Before new farms reclaimed from the sea are turned over to the settlers, the immediate farmstead area surrounding each combination farm dwelling and barn has been planted to adapted trees and shrubs by the Dutch Forest Service (under the guidance of a landscape planner). Again, this is done primarily for the purpose of making life for the settler more agreeable and minimizing the sweep of the cold winds of the North Sea.
>
> The planting of trees on reclaimed land is for the landscape. This term means more to the Dutch than our words "Parks" or "recreation areas." It means nesting places and

> shelter for birds and small animals, shade and shelter for family picnics and variety in an otherwise monotonous and unvaried landscape across the erstwhile floor of the sea. No favorable monetary benefit cost-ratio led the Dutch to their decision that life for the settlers in the new polders would be more rewarding if up to 10 percent of the reclaimed land was set aside for small forests. (4-550)

The Dutch philosophy could provide a lesson for American urban and rural planners, developers and Government officials.

In the midwest the grid system of land subdivision is unpopular with many contemporary Americans, chiefly for esthetic reasons. But the preference for 'natural' boundaries runs counter to the well established tradition of artificial or man-made boundaries.

West of the Appalachians almost every boundary has been determined by the grid. A map of any large section of the United States today resembles an immense composition of squares and rectangles, regardless of the nature of the terrain or the type of exploitation. This grid system of land use expressed very clearly the general cultural belief in equality of opportunity and in the possession of land as one of the bases of citizenship. That was in the day of the independent and more or less self sufficient farm. When, after the Civil War, settlements pushed out on the Great Plains and farming became more a commercial enterprise, the disregard of the topography and the assumption that all pieces of land of the same size had the same value created a cultural landscape often totally unrelated to the natural landscape.

This was especially true when the farm settlers invaded the relatively dry and treeless region west of the 100th meridian, which cuts through the western half of the Dakotas, Nebraska and Kansas. Without today's irrigation systems, land past that line was really unfit to farm, and the square of 160 acres had no real value as a farming unit. The consequent trend of farms to increase in size either by expansion or consolidation, accounted for many of the changes in the cultural landscape of the Plains. The increased size of farms and fields, together with the introduction of barbed wire fencing, was the beginning of a new scale of rural landscape in America. It resulted in an intense spaciousness.

Today when we fly over the grid landscape we can see the effect much more clearly than those people who traveled by train or wagon, and from the sky, this human stamp on the land looks especially impressive. A century ago travelers could only observe a straight country road between fences or straight rows of young trees and a perspective of corn-wheat fields.

If fences and gates express a cultural part of farming, the barn has made an even stronger and richer impact. With the influx of people from the different farming regions of the east came a great variety of barn styles to the Great Plains. Many of these old barns have collapsed, yet enough are still standing to provide us with a rich cultural heritage. The difficulty is that many of these buildings are no longer functional for today's modern farming method and upkeep is expensive.

The older barns show us that with the increased scale of the farming landscape, expressed in the larger fields and larger holdings, there also was a revolution in barns. Larger and more spacious barns were needed, and with the invention in 1830 of the balloon frame, this could be achieved. The balloon frame allowed for greater interior spaces without interruption and it was relatively easy to modify. The structure was ideally suited to the Plains because it could store large amounts of hay. And because the balloon frame construction suggests possibilities, every farmer became an innovator in the designing and building of large, free interior spaces with all the accommodations in one building. The structure was less expensive than the older style barns. Labor was saved by placing everything at hand. The final touch on the barn was of course the "red barn" or any color design which was accepted for the area, including the Hex signs and other ornamentations.

The remaining old barns are a first resource for landscape planners of our cultural landscape of the Great Plains, just as they inevitably attract photographers and painters looking for something which expresses the character of the Plains culture. But they serve the planner as a resource not because they are picturesque but because they conform to the four principles of a cultural landscape enunciated at the beginning of this section: they are regionally distinctive, intended to be highly functional, evidence of human labor in the relatively distant past, and (as the photographer and painter appreciate) it expresses a harmonious relationship between man and his land.

Means of Conserving the Cultural Landscape of the Great Plains

We must know our home environments before we study others. The old rural landscapes, examples of our cultural heritage, are valuable sources of information to be used in creating the new forms of future societies. As we learn to restore and improve the landscape, especially on a large scale, there is a temptation to think that it is necessary to achieve an instant landscape whereas other generations have been willing to consider the landscape evolving on the basis of conservation principles practiced by agricultural communities. The subjective source of these principles, of the dynamics of management of the cultural landscape, is related to the record of history and man's awareness of that record in the landscape about him.

Could the fact that the Great Plains have the sparsest population in the United States be a stumbling block in the development of an esthetically pleasing landscape? Fewer people grew up in the Plains and consequently fewer people have a concern for an attractive cultural landscape? Of course there were also fewer people to destroy or pollute, unlike the case of people concentrated in the cities. Fifty years ago Jensen remarked that in certain ways our cities are actually less pleasant places than they were two generations ago (11-38).

The cities on the Plains seem to disappear in the vast open space. These cities should experience the effect of the landscape surrounding them and could be the examples of new towns, like those Jens Jensen had in mind in 1920:

> It is evident that the first consideration must be given to the esthetics in our parks--play being at all times subservient. There are multitudes who rarely get beyond the city limits and who obtain a great amount of physical exercise in their daily work but lack mental stimulus. They need the out of doors as expressed in beauty and art and a broader interest in life. They need the quietude of the pastoral meadow and the soothing green of grove and

> woodlands in contrast with the noise and glare of the great city. (11-38)

Jensen's idea was the construction of parks which were based on the natural and cultural landscape found in the region--i.e., the prairie landscape. Such an environment provides roots, not only in the immediate present but also in a cultural past. A good example is the state of Israel. The Jews have created in the state of Israel a homeland to enclose their cultural and ethnic history. This patch of desert is not merely a territory colonized by a few, but a country filled with symbolic meaning for many (6-15).

The Great Plains a century ago was anything but homogenized in its ethnic background. There were Bohemians, Dutch, Swedes, Hungarians, Russians, Germans, Norwegians, and people who have moved from the eastern part of the United States. When they settled they lived in the isolation of their culture among their orchards and fields. These people each had their inherited cultural background which they brought with them and again tried to express.

When Jensen left Denmark in 1860 he left the ancestral village where the family farm had been in the family for more than four hundred years. Characteristically, the planting around such homes was both attractive and functional, serving to screen the house from the elements. There is ample visual evidence that the farmer of South Jutland had a deep and abiding knowledge of the uses of plant material to adorn and improve the native landscape. It has been suggested that this characteristic attitude toward the rural landscape was perhaps the most important piece of cultural baggage which Jens Jensen brought with him to the United States (11-5). He shared his attitude toward the land professionally through becoming a landscape architect.

Jules Loh wrote a feature article about Edward Durell Stone, architect of many outstanding buildings. In the article Stone is quoted in this reflection on the American landscape:

> A bird's-eye view of our country might lead to the observation that Americans can afford everything but beauty. I once flew from Venice to Akron, Ohio, and when I landed I decided the so-called poor people of Italy were a lot better off.

There is a starvation of the spirit in this country. Man deprived of beauty, of esthetic pleasure, may turn in his ignorance to pleasures more base and brutal to alleviate the boredom.

What can be done about it? In Paris, no citizen can change a doorway or a gable without government approval. This would not suit our culture but we have to make sure somehow that what affects the future is planned for the benefit of future generations. The French wouldn't think of building a highway without planting trees along it. Transparently, those trees aren't for the enjoyment of the planters, but for unborn Frenchmen. Their countryside isn't very different from our Midwest, but all their highways are lovely avenues of trees. I might note here that Napoleon encouraged planting of trees along the highways for the purpose of camouflaging the movement of his army troops. What was intended functionally was planned esthetically. Now the function is no longer needed but the after-effect of the planning is felt by later generations.

In his reflection on cities Stone says:

> The sad thing is we started out with such promise. Charleston, S.C., New Orleans, Salem, Mass., beautiful cities and the

> oldest part remains the most beautiful, imparting a sense of permanence. It's doubtful whether anything in history has existed as poetic as the New England village green with its stately elms and Christopher Wren church spire and the quiet elegant houses of the affluent villagers. (24)

Loh writes that of consuming interest to Edward Durell Stone is what he considers an urgent need today to uplift the human spirit.

Both Jens Jensen and Edward Durell Stone express a need for deep love for the land as a starting point, and to attain this may be difficult for us because we have been a society on the move; none of us has a family home place which traces back five centuries and many have no sense of place. Our society does not allow us to identify with an area. It changes too often and too rapidly.

How we relate to our environment is therefore much more difficult to express for a citizen of the Plains. What the environment means to us in terms of literal perception, whether it is coherent, esthetically interesting, jumbled, and what it means in terms of value and function is not always the same. Certain landmarks help us find our way about a city quite apart from their usefulness as buildings or parks. Symbolic communication is implicit in most settings, telling us what to expect of a particular setting and beyond this how to evaluate ourselves in relation to it. Burnett called this role of the environment a "fundamental reference system" by which we interpret the significance of a setting.

It is this quality of the environment that provides man with that sense of "place identity" which helps to define the role he plays in society (8-14). How do we cultivate this sense of identity?

In Alan Gussow's A Sense of Place, there is a collection of paintings by different artists depicting landscapes and a few city scapes in the United States. The book is a reproduction of the paintings which have been on exhibition across the states especially the Midwest. The intention of the paintings shown in the exhibition, and in the book, is to encourage each one of us to attend to roots, to notice what is about us, to involve ourselves deeply in our own locations, and to recognize that in some hidden way we are the products of our places. The exhibition teaches us that in the end we are not distinct from our landscape for as we give shape to our villages and cities, these places in turn shape us.

This visual method of sharing and showing, is one way of teaching landscape appreciation. But undoubtedly more education is needed to make people aware of the importance of the cultural landscape. The movement to educate the people is looked upon by many as the only solution. At the White House Conference on Natural Beauty (1965) education was one of the recommendations because only when there is a well informed and concerned public is it possible to get a county government willing to utilize all the available tools. The county unit is the political entity which has government power for action within its jurisdiction. There are over 3,043 counties in America, each of which may be a catalyst for a combined effort.

The methodology of teaching undoubtedly will have to be studied and adapted for each age group. To inform the future generations we should begin by concentrating on the age group of six to fourteen which profits most from organized instruction. The earlier the experience the more useful will it be as later educational challenges involve facing up to similar problems (15-3).

Teaching should use the natural history approach. Interest should be cultivated in the living animal and living flowers in the living landscape (46-104). As Aldo Leopold in A Sand County Almanac wrote:

> When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap the esthetic harvest it is capable, under science, of contributing the culture. That land as a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known but later often forgotten. (23-18,19)

The intention of this dissertation is to play its part in the movement to cultivate a sense of place in the citizens of the Plains. Its aim is to show all the kinds of information necessary to educate the landscaper in practicing his profession in this region. But instead of beginning with a list of plant material useful for landscaping of a minimal kind, it argues that, because of the distinctiveness and even uniqueness of both the natural and cultural landscapes, the designer must be aware of how the two landscapes evolved from the beginning of time. And even more important than this scientific and historical knowledge is the awareness on the part of the landscaper that his first problem is psychological--to match or harmonize the psychology of its citizens to that of their habitat on the Plains. The fundamental means of conserving the cultural landscape is therefore this matter of the psychology of the citizen or inhabitant which can be modified only by a great variety of educational approaches, of which this dissertation is but one among many.

Principles and Materials for Landscape Design on the Great Plains

Who does landscape planning on the Plains?

In the whole world relatively little landscape planning has yet been carried out in the full sense of a survey, plan, implementation, and then monitoring of varying degrees of success. In the Netherlands, parts of Germany, the British Isles, Israel, the United States and Canada and possibly a few other countries a little has been proposed, less started, and only fragments completed.

Where progress has been made it has been coupled with major land reconstruction schemes; for example, land reclamation in the Low Countries and flood protection in the river basins. The systematic study of problems and possibilities of landscape planning has started fitfully, building on the skills of many specialists, but has not really been drawn together as a mature academic or professional activity. Many landscape architects have appreciated the need intuitively and attempted empirical applications. As their training improves their links with some of the necessary expertise in ecology, wild life conservation and resource management, hydrology, and other fields also improves. The fusion has been more successful where large scale regional planning studies have brought all these people together.

Nearly all early regional plans include "landscape" studies of the descriptive kind with varying degrees of quality in survey information, its analysis and evaluation. Later studies are more thorough in their processing of information. The works of McHarg and Lewis in the United States and Hills in Canada show this progression from the descriptive with cartographic and graphic presentation towards the vigorous analysis and evaluation. As might have been expected the systems analysts and the computer men have been well placed to explore the problems, as can be seen in the progress made by Carl Steinitz at the Department of Landscape Architecture at Harvard University. His work is characterized by computer analysis (designed for graphic display) and the interdisciplinary approach. At the project planning level in Britain the team discussion and report has been a typical method and one of special value if proposals have been the subject of later cross-examination at a public inquiry.

At this stage it is possible to identify two kinds of clients for professional landscape planning skills.

a. those with territories or projects, and a budget to enable implementation of planning, such as county planning, national parks and new towns authorities.

b. agencies which commission or carry out studies, such as regional planning teams, subregional planning studies, countryside commissions as in England, Wales, Scotland, the Netherlands, and Germany.

Landscapers may be found in direct salaried employment but are more usually in University departments among their research workers, or act as consultants who bring together ad hoc teams to do what is still very often pioneering work. The landscape planners usually have to present their analysis and evaluation in ways which are readily understood by other professional planners, and which provide the information on which political decisions can be taken and substantiated (25-57).

If we accept the philosophy of a sense of place expressed in a cultural landscape of the Great Plains, and agree that it is possible to reinforce this by encouraging the creation of typical local landscapes which emphasize their better and more attractive characteristics, we must admit that at no time in the near future will regional landscape planners look after the landscape of the Great Plains. The development will continue to be arbitrary and largely left to local taste and order. In the final analysis, then, the people themselves are landscaping the Great Plains, for good or ill. Any help they can be given to create a better landscape will be of immediate value because the results will be carried into future generations as a testament that this generation loved the land. As was suggested earlier, the first step of the landscape design in the Plains is to change the philosophy of its citizens towards their environment. And, this is eminently logical and practical since those citizens are their own landscapers.

What are the Aims? The development of a new cultural landscape in which simplicity will be the main characteristic, as it is the true character of the Great Plains, is possible because of that simplicity. It can be implemented immediately because the costs are much lower when a development is individual or community oriented. The often high expenditure of labor is omitted when people do the job themselves.

And, with such people involvement, the results are greater if guided properly by the landscape designer.

Sensory, perceptive, and intellectual pleasures are all to be obtained as the result of the designer's skill. He should recognize each for what it is, and strive for the greatest total result. Repton said:

> I confess that the great object of my ambition is not merely to produce a book of pictures but to furnish some hints for establishing the fact that true taste in landscape gardening as well as in all the other polite arts is not an accidental effect, operating on the outward senses, but an appeal to the understanding, which is able to compare, to separate, and to combine the various sources of pleasure derived from external objects, and to trace them to some pre-existing cause in the structure of the human mind. (7-85).

Because different men sense and appreciate landscape differently, the response of one man in judging a landscape will employ a scale of values different from those of another man of a different type of mind. This is the reason for employing trained experts, landscape designers who can best discover the relationship between the natural and the cultural landscape character, and use that as a guide to prevent a landscape effect which appears to be a matter of individual taste only--and his, at that.

The trained designer will not go about with a store of ready made features and effects in his mind, and strive to fit some of them into the task of the moment as best he may. He will conceive his general idea in deference to the local commands of nature, develop his general scheme as artistic fitness counsels, discover the special features which are needed to complete it, and then search for scientifically known natural results which will teach him how to achieve his own. In his training he will have been taught less to remember than to understand how nature goes to work to produce beautiful results. He will have tried to permeate himself with her spirit, to comprehend her aims, to learn what she may by variety in unity, by effective simplicity, by harmonious contrast, by fitness at feature and detail, by beauty of line and color, by distinctness of expression—in a word composition. His aim is true and trained composition (11-122).

What Materials are Available? Plant materials: Landscapes depend primarily for their character on ground form or vegetation, and to a greater or lesser degree on the hand of man. On the Great Plains a fourth dimension, the sky, must be added to the composition as it very rapidly can change the aspect of the landscape.

Historically the rural landscape has been made intuitively by the people who live in the Great Plains. Esthetics has not usually been a prime concern. For example, when the Department of Agriculture Trees Planting Program was originally set up through the soil conservation program, the planting for esthetics was specifically ruled out.

To help fill this esthetic gap when faced with the challenge of design, it will be necessary to use all the scientific knowledge outlined in the previous chapters in order to stimulate the imagination. The first materials are the evidence of slow changes which have made the landscape as is observed now. Likewise, on the Great Plains it is often small elements which have a great impact on the landscape; a group of trees in a cluster or in a row along a stream or road; a single tree near a draw where moisture collected. If such relatively small elements have impact on the Great Plains scene, then even small landscape plantings added to the landscape would have a major impact.

In the Great Plains the visual aspect of open space is probably the most important material. People see the open space as a wide expanse surrounding them. In such an open landscape groups of trees and shrubs and hedges provide the "masses" of a composition in contrast to the voids consisting of the lower growing farm crops such as pasture, wheat and prairie grasses. This division of space is sensed especially in the smaller fields enclosed by windbreaks. Open space on the Great Plains today can be exhilarating. It is different from the enclosed areas around homesteads and the towns. In such smaller places the effect of plant materials can be intimate as we can observe them daily, and appreciate their function in providing protection from the wind of winter and the heat of summer.

The skyline holds a special attraction for the eye on the Plains. More than one skyline may be visible from some positions, one formed by the outline close at hand and another by land forms and other distant objects. There may also be other attractive horizontal lines such as hillcrests or ridges which, though they do not actually reach the skyline, are clearly defined and hold their own interest. When such a view can be framed by a group of trees the pleasure of viewing is increased by the designed framing. The vision can be focused by the careful placing of one tree only, which then may serve as a focal point to the distant skyline.

Where existing trees obstruct a view, the removal of lower branches may open the vista; often only one branch need be removed to obtain the visual freedom. The removal of excessive underbrush to clear the trunk line down to the ground will reveal the intersection of the vertical tree form with the horizontal land form. Cleaning out underneath helps in locations where we want to observe the trees or where they encourage us to look at them. In hedgerows, or at the edge of small wood lots, the underbrush is often part of the vegetation and enhances the setting and consequently should not be removed.

On a very large scale plants must provide the very structure of the design just as brick, stone, and timber provide the structure of a building. In a wide landscape the structural framework must be formed of earth and vegetation--mass and void in balanced groupings. It is a challenge to create a typical example of the local landscape where a rest stop is situated along the highways. Many of the rest stops are oases which do not at all reflect the character of the landscape through which one is passing. If it were a representation of the character of the local landscape, then stopping and looking around would be an experience like eating in a local restaurant rather than a Howard Johnsons.

In the case of a rest area the smaller space can give a sense of coziness and comfort from which to view the open landscape, range, or farm land. Here light and shadow may be used as an integral part of the design to reinforce the feeling of coolness during the summer heat. Alternatively a feeling of spaciousness can be encouraged through the use of plant material to make an enclosure which opens on to a grassy area as in a park. If the grass area has an abundance of prairie flowers (and people are asked not to pick them) the physical rest would be something more than just using the facilities, stretching one's legs, letting the dog out, and then driving on.

Homesteads: An integral part of the Plains' landscape are the homesteads. Even when the various buildings are in themselves undistinguished, farm groups usually look pleasing in their setting because of the compact functional grouping of the differing shapes and sizes of structures and the rational scale relationship between open space and built up areas. Trees and windbreaks, and sometimes hedgerows, link the homestead buildings to the land. Often one color paint unites the buildings together. Sometimes a particular color is accepted in a region and then the uniformly painted buildings have a very strong and often extremely attractive regional landscape effect.

It is sad that today interest in homestead tree and shrub planting is lacking because many farm families now depend on their air conditioned homes for comfort. Trees and shrubs can perform that function and help to visually relate the structure to the site. The simple functional lines of farm buildings generally call for a somewhat freer use of plant material than is generally practiced. The restraint undoubtedly is caused by the open spaces needed for today's many and large pieces of farm equipment. But some plantings of trees on a reduced scale away from the strict rectangular square pattern would increase the esthetics of many homesteads. Well placed trees would give the feeling of three dimensions--they not only indicate spaciousness through indicating width or depth but, also height, when mature. The creation and appreciation of spatial volume is an important part of the enjoyment a good design can provide.

When trees serve more than one purpose (e.g. providing wind shelter, forming part of the skyline, tying roofs and buildings to the site, and providing shade) then they really belong functionally and esthetically to the landscape. Therefore, whenever possible, shelterbelt or windbreak plantings should be designed in relation to land forms. Too often in the grid system imposed on the Great Plains the shelterbelts, especially around homesteads, lose part of their attractiveness because they simply follow the grid lines where an attractive contour line could easily be followed. Windbreaks influence the direction of air currents according to the wind speed. Fast traveling gales can be steered away from the ground with a streamlined or rising planting on the windward side. Such a streamlined windbreak of some width and height leaves a wide area of shelter leeward.

Shelterbelts: Farmstead windbreaks for winter protection normally screen the north and west sides of the area to be protected. Field windbreaks are placed along the south or southwest side of the field. To reduce soil blowing and crop damage, parallel east-west belts were planted at intervals of twenty times their height, or at a distance of about one-eighth of a mile. Today many of these windbreaks have been removed due to the use of large farm equipment. This has increased the scale of the Great Plains landscape and has changed its agricultural character, emphasizing the need for windbreak plantings around the homestead to stabilize the loss of landscape character.

To compensate for winter snowdrifts 100-150 foot buffer strip between windbreak and building or roads is allowed for drifting snow. Except for removal of dead or diseased branches windbreak plantings should not be pruned. Pruning reduces density and therefore lowers the capacity of the windbreak to stop wind and snow. The trees in a windbreak give up their individual form to create a new composition of form but that farm is never completely enclosed. Shelterbelts should never completely surround a site; they deflect the force of the prevailing wind without preventing passage of air in other directions. This prevents air stagnation which is the result of too close planting.

Woodlot plantations should be situated to help shelter farms and livestock and to prevent soil erosion, if the landscape is to be satisfying. This functional relationship of farm and woodlot will create an attractive pattern whereas if the two are unrelated the square tree plantations appear as intruders in the landscape.

Single or small groups of trees seen from the roads need more than just preservation. They need maintenance and occasional replanting. Many of the distinctive clumps, often purely an act of nature or the provision of a far sighted farmer, help to make our roads more interesting. Especially with these trees, local pride and appreciation of the rural scenery might be one of the most powerful means of maintaining and improving such a characteristic landscape.

Rock Formations: The ancient Greeks were honest with nature. Their art was not to impress but to make the part clear, a spring, hill or rock ledge, or, as Jensen said, to let the landscape speak (11-140).

Each place was designed to reveal the meaning of the landscape, to reveal what had been obscure.

In the Great Plains the landscape is and should always be one of a general horizontality with just enough vertical lines to supply the needed contrast. The extensive horizontality is well expressed in the stratified rock formations which indeed echo the horizontal lines of the prairie.

Rock appears in the landscape as outcropping ledges of natural stone. These rock ledges when subjected to the action of the weather, especially frost, will in time break up into separate rocks. If the slope is not too great, these rocks will often remain more or less in their original position. By their related forms, the direction of the fissure, and their stratification, they show the character of the parent ledge. Groups of rock so formed often produce in nature particularly unified and interesting compositions which should be a guide when man-made naturalistic rock work is necessary to hold a bank. Such rock can be laid up at a steep slope. The choice of rock material should have stratification and cleavage similar to that found in the area. The arrangement of the rocks should simulate a solid ledge with a closely grouped structure, scattered at the edges but always suggesting the parallelism of the natural strata. If this is done the result will be a strong unity with the general landscape. Just as in nature, at the foot of a steep face of rock there may be a tallus slope, a jumbled pile of dislodged fragments. When rocks are used as a part of a valley side they will normally form the projecting, dominant parts of the bank, and by doing so, assume importance in a composition.

In all rock structures texture and color of the rock are important. Because rocks normally give a feeling of strength and sturdiness they do not need to have a bright color. The earthy color is generally most appealing; weathered rocks express a naturalness; often rocks dug from beneath the ground do not fit in until a year or more has passed. Mosses and lichens growing over rock add to their character. It should be observed at what location such rocks were found (i.e. a sunny or shady spot) and care taken to place the rock in a similar locale if at all possible.

Water: The horizontal, stratified lines of sea or lake deposited rock are even more strongly expressed by a lake itself. A lake surface is a united element in its surroundings. It lies all at the same level, often establishing a very interesting contour line. The expression of water through sound, motion, and current is a landscape characteristic always stimulating. The forces of wind on the surface may change a quiet ripple into small white heads on waves and even larger ones depending on the size of the lake. Its range in emotional effect is so great that it is an experience set well apart from all other landscape elements--except the sky of the Plains. Indeed the sky provides an experience with the clouds somewhat similar to viewing a lake. In both cases it is best to stand somewhat higher than the general landscape to see the full effect. The big windblown clouds in a blue sky make a play of shadow on a sunny day over the Plains.

Lakes are almost always formed by the collection of water in a valley hollowed out by some earlier geologic force. The lake obtained its form from the existing valley, the water running up into coves with smooth flowing curves. The promontories in the lake are formed by spurs of the surrounding hills connected with the high land to the rear. Sometimes a hill tip is left and sticks up out of the water as an island. Often its location and form continue or repeat the form of the surrounding land surface of which they once were a part.

The power of reflection gives any water surface a strong appeal, and is a strong landscape element, and should be used to its greatest advantage in any composition but especially the smaller ones, such as a pond where the reflection of a tree or building will add interest.

Roads: Roads are an important element in the landscape because they allow us to enter into a region and connect one area with another as we drive from one place to another. Lynch in his book The View from the Road gives three design objectives for a good road.

> The first one is to present the viewer with a rich, coherent, sequential form which has continuity and rhythm, and development which provides contrast, well joined transitions and a moving balance. This form may be built out of sensations of space or those of motion (both of self or the external environment). It may be constructed from modulations in light, color or texture, from roadside detail, or perhaps even via secondary senses such as sound, smell, or touch.
>
> The second objective is to clarify and strengthen the driver's image of the environment, to give him a picture that is well structured, distinct, and as far ranging as possible. He should be able to locate himself, the road and the major features of the landscape, to recognize these features with surety, and to sense how he is moving by or approaching them.
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> The third objective is to deepen the observer's grasp of the meaning of his environment to give him an understanding of the use, history, nature, or symbolism of the highway and its surrounding landscape. The roadside should be a fascinating book to read on the run. (26-56)

Ideally all objectives should be achieved by means which interlock at every level. Lynch divides the road experience in view prints and landmarks. Both these are made up by major landmarks such as towers, churches, impressive vistas, unusual scenes, and forms which have dominance, i.e., open spaces such as squares, plazas, recreation areas, parks, cemeteries, intersections, and cul de sacs.

The road is expressive of past associations (historic sites, events, site association with significant personality or historic group) and with present associations (activity sites such as schools, a major group such as a shopping center, and visual communication such as signs).

Roads should fit the environment. With the past adherence to grid system one of the worst road features is the cuts through ridge tops in a direct line of sight from the roadway. This creates an unnatural break in the skyline. A combination of vertical and horizontal curves will make the road appear fitted to the landscape. On newer roads these practices have been followed. Such a good relationship of the road and terrain can be achieved by skirting open fields or crossing vantage points from which such openings can be seen (17-224).

Other things being equal, movements which are most agreeable are those which are consistent in character and easy to follow. In the scene the straight road on the grid should fit well but there is many a road which is perfectly straight, without obstacles or difficulties, and which is a real bore to travel on. People prefer a road along which they are entertained. There is a perfect illustration of sequence in a straight line, but one gets through it quickly and is not at all interested.

The interest and attractions which are set together in any sequence should have a logical connection and relation and the relation should be one of sequence. The first interest should lead to the second, the second to the third, and so on. By this, unity is secured with no serious loss of interest or of attraction.

It may be of interest to note that, in a study to find viewers' preference for a landscaped route versus a commercial route, the removal of billboards and utility poles caused the roads to be experienced as extremely monotonous and depressing. "Turnpike Hypnosis" is an example of what can happen in such a situation. In Texas certain long flat stretches of road are now decorated with billboard sized works of art (8-291).

Small Towns: Typical of the Great Plains landscape are the small towns. Small towns seen lying compactly within a wide landscape exhibit very attractive parts of the landscape character which larger towns cannot show. With many of these small towns the relationship between the town and its surroundings can still be seen. The reason for the town's existence can often still be seen; for example, a place where a stream could be forded or streams diverged. Or perhaps protection was sought at the head of a valley on sheltering to the leeward side of a group of hills.

In general the situation which does provide the best shelter and convenience for a town is that where the landscape will most readily accept new structures, and new shapes most readily blend in with the existing land forms. Bold plantings of trees will help to reconcile building and land forms where the situation is not ideal. The selection of tree sites should be part of site planning and not an afterthought. In towns where there is little variation of scale and much repetition of equal forms, there is a need for tree outlines to lift the skyline. Where there are larger buildings of an attractive form, such as towns, part of a skyline can be left to these rooflines.

The older towns often had an intimate character because buildings were compactly grouped together. New housing developments, because they are built with less site selection, often miss the intimacy of the older sites.

The satisfactory results of a closer grouping of buildings in a town depends very largely on the relationship of the building group and green space. Compactly grouped buildings differing widely in form and mass, but functionally related to broad open spaces containing trees and shrubs, make a far more attractive and interesting unity than evenly placed separate buildings of nearly uniform size and situation over an equal area. Many new housing schemes have trees scattered about aimlessly. They occupy empty space without any specific function. Most of the positive function to be served by trees calls for groups rather than for single specimens. Open spaces which do not invite constant use are not an intimate part of a town landscape. They are often wasted space.

In larger towns tree belts or parkways with ample plantings may help to divide the different sections of town, separating industrial areas from the various neighborhoods. The result is greater individuality for each, and the elimination of industrial factors such as noise, dust, and other environmental nuisances. At the edge of town a clearcut sharp distinction between town and country improves the visual impact greatly. The difference, if strongly marked, provides a large scale landscape contrast which contributes to the enjoyment of both the natural and the cultural landscape.

The amount of time spent by the townspeople in the open air, depends to a large extent on the design of a town. Do the open spaces invite people in to them? Are they functional as a thoroughfare to the shopping center? Do the trees provide shade or shelter? Typical of the Great Plains small town are the tree plantings providing avenues. But too often with modern day traffic there is a conflict between speed and shelter unless the roads are wide. As a variation of the street planting, a single large tree or a group of large trees suitably located with some space around them, may give an attractive and stimulating alternative and provide a different note in the town's skyline.

With the increased road width needed and extra paving, excessively dry conditions are created in the topsoil near many of the trees planted along the street. A wide unpaved strip of ground which provides better biological conditions would also give a much more pleasing appearance to the town's landscape. It would help to display the vertical trunk on the horizontal green lawn or other ground cover. If trees must grow out of pavement then a grill should be provided around the base of the tree to admit water when possible. The fall of the paving may be arranged to drain moisture to the tree roots.

Whenever it is possible to locate important tree groups on rising ground they help to relate the town to its topography by emphasizing existing land forms, but sometimes the open ground form surrounded by trees and houses is just as much a part of a community, depending on the use of the land.

Many of our small and larger towns are located near a stream or river, which was the reason for their existence, and these provide a real opportunity for interesting landscapes. The stream can be a focal point for spatial arrangement, but too often it is forgotten and polluted. Any natural element which keeps the town in contact with the countryside beyond may be worth preserving to fit the town better into the total landscape character, and many such areas are ideally suited for parks.

<u>Parks</u>: When designing parks the aim should be to spread people out, providing accommodation for many people without losing the sense of intimacy. This can be achieved by having many centers of interest with the scale of each adjusted so that the separate groups do enjoy a sense of seclusion but not total enclosure. In a large park the subdivisions within the park need to be defined and given some sense of unity, such as a naturalistic area near the river, or a more cultivated area with flowering shrubs. Plant material can mark such division without being dense. Open areas are stimulating and interesting and can be used for play or to provide a view; but such areas do not need

to be too large or they can give the feeling of being lost. Each area should be in scale. Roads and foot paths form the main skeleton of any town park, providing the design guides the traffic to areas and structures. Large buildings either for social or administrative use are generally more conveniently placed on the boundary together with the parking spaces rather than within the control part of the park.

Flower gardens attract older people and young children. Wide paths, good seating accommodation, preferably with shade and sheltered from the wind, should be provided. The design principle to follow here is simplicity. Too often plantings are overdone by too varied groupings and too many colors in any planting. Here too is a need for unity in the design to relate the planting to the architecture.

Cemeteries: Cemeteries are part of our landscape and a country cemetery with its church close by does give a real sense of community. Many of the older cemeteries convey a sense of place but newer ones, with their great and excessive variety of tombstones, are unattractive areas in the landscape. A simpler design, as often seen in the older places with natural stones used for headstones, would be a good starting point to try to make cemeteries more like park space with open lawn and clusters of trees. In some of the larger cities where there is little space to waste, such a cemetery can provide valuable open space.

Industrial Plants: Industry, more than any other factor, can have a great and rapid adverse impact on any landscape. We can live with industry if it is used to serve man and does not detract from the quality of human life. In almost every case of industrial damage to the scenery it can be shown that the cause of the ugliness is waste of space and water material piled up on the grounds. The wasted space near industrial buildings and complexes could easily be converted into an asset if trees and shrubs and grass were used and ground modeling was carried out to help hide unattractive areas. Trees should be planted in groups where there is room, and used for rotational felling. In order that some revenue be secured, large open spaces could be grazed rather than mown, except near the buildings.

Where the space is too small, ornamental plantings are in order. But trees, perhaps of smaller size, are still better than small flower beds which can best be used in critical locations near the main entrance. A good effect can be obtained through the use of large containers, related to the architecture of the building.

High chimneys and towers cannot easily be hidden and that is not even necessary if massed planting of trees and shrubs give a firm horizontal base line to provide a balance with the tall structures. To keep the landscape simple, plant material should be used to screen the parking area. A high bold vertical structure needs a strong horizontally extended base of vegetation undisturbed by clutter. Such functional use of trees and shrubs allows industrial buildings to blend into a wide open landscape. Just as with towns, the surrounding landscape should be brought right up to the industrial complex to help complement the buildings.

It should be kept in mind that often industrial blight spreads as more industry is attracted to an area. Therefore, good planning is important to set the trend. New industrial sites often start on a clean slate. All existing trees are first removed. A close look at such trees may encourage builders to leave them if possible in order to give immediate landscape character to an otherwise bare site.

Wheat Fields: To create an attractive landscape one has to combine shapes, textures, and colors in an orderly fashion. The units of the landscape should be arranged in such a way that attention moves along from one to the other. This is called sequence. But the units may all be the same in their interest value and consequent ability to attract attention--this is repetition. Repetition is the most fundamental of the laws of order. To have harmony there must be repetition. A varied landscape may be unified by being predominantly of one basic color, for example green.

The wheat fields on the Great Plains give unity in color and texture and to some extent form. They provide sequence by mass as observed from the road. They provide balance as they occur around us seen from where we stand. The latter may be unsymmetrical balance, not similar or similarly placed but still so chosen and arranged that the sum of the attractions on one side of the vertical axis is equaled by the sum of the attractions on the other side. One tends to keep looking for all the parts until the scene is balanced.

The Eye of the Beholder: One physical consideration which tends to limit the field within which the attention can be attracted by objects in a pictorial composition is the fact that the human eye is so constituted that objects can only be clearly seen at the same time if they lie within the so-called angle of vision, normally about twenty degrees.

The pictorial or compositional relation of objects can be well perceived only when they lie so close together that the attention is attracted to each of them according to its value in the composition and not distracted by the necessity of turning the eye or turning the head to bring the different parts of the composition into the field of vision.

A person may stand before a landscape and without moving his body see half around the horizon; but it is only if the landscape unity is composed within the visual angle that he can well appreciate it as a pictorial composition.

A landscape composition, however, may give pleasure even though it covers a wider angle of view than can be included in a pictorial unity. As the compositions are longer and less likely to be all visible from one place, so does remembered effect come to play a larger and larger part in producing the total effect of the composition. Thus consistency of style of character and emotional effect become more and more important as unifying factors in the design (18-92).

Conclusion: The main design principle of landscape on the Great Plains is the character of the people themselves--that is, simplicity, and to convey this effect, must therefore be the intention of the landscaper. To achieve what he wants to present to the eye of the beholder he has several kinds of materials to work with, all of them involving the use of plant material.

CHAPTER V

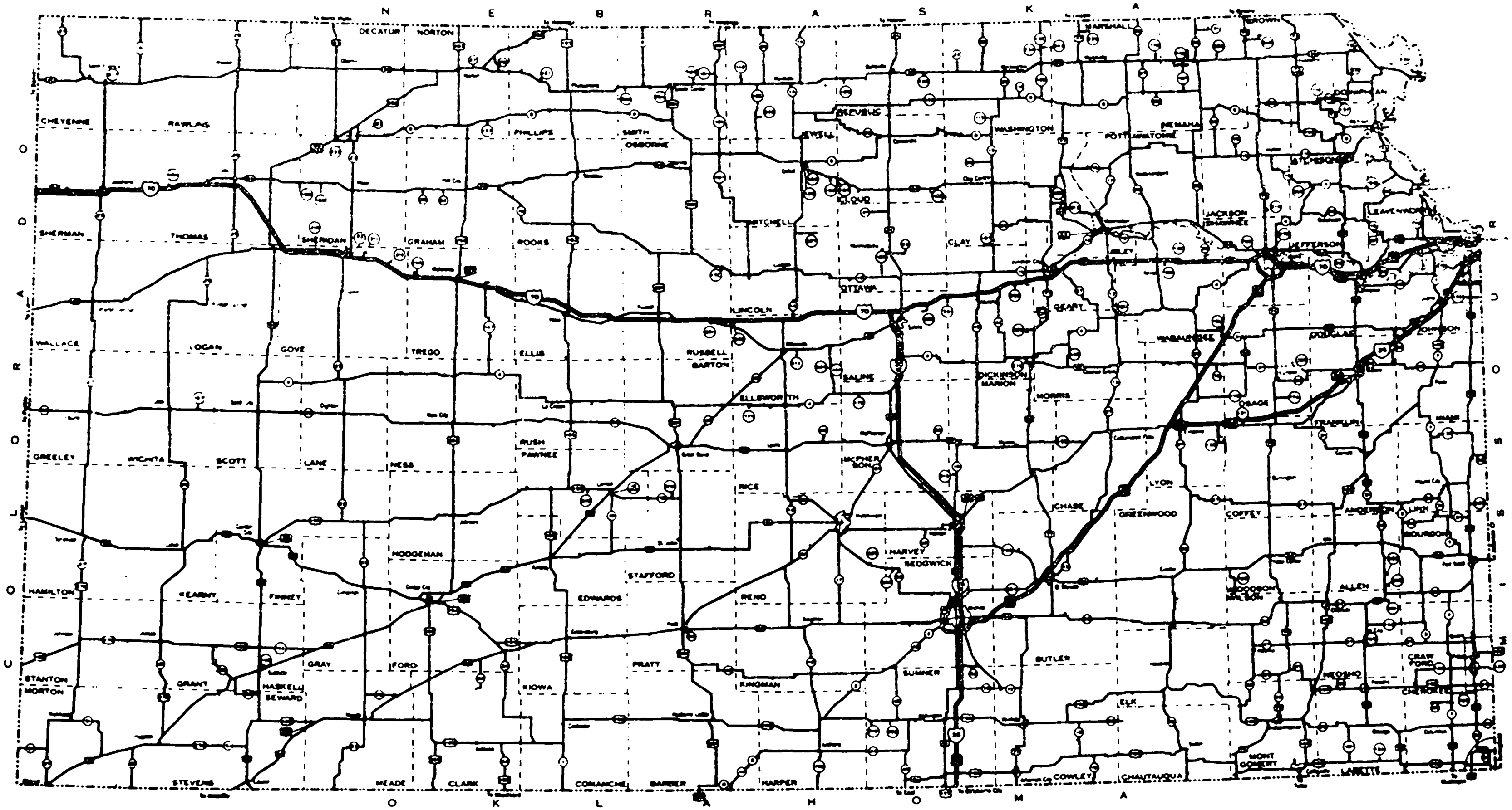
CASE STUDY OF KANSAS LANDSCAPE

Kansas became a state on January 29, 1861. Behind it were bloody days which had erupted over the slavery question and still further in the background was the history of the exploration and settlement of the vast area that became the Louisiana Purchase and the Kansas Territory. The state of Kansas is an area 411 miles long from east to west, 208 miles wide from north to south. It is rectangular in shape except for the northeastern corner which is cut off by the Missouri River (Fig. 2).

For the western world the story of Kansas began in 1541, when the Spanish explorer, Francisco de Coronado, accompanied by thirty horsemen and a Franciscan friar named Juan de Padilla, marched onto the Great Plains. They had left Mexico in 1540 to explore the vast new area of "Quivera" and to search for gold on behalf of the king of Spain. By the summer of 1541 they had reached what is now the Arkansas river, crossing that stream near the present town of Dodge City.

During the years between 1682 and 1739 France sent several explorers to the Kansas area. Claude du Fisne crossed southeastern Kansas in 1719 and Bourgmont arrived in 1724. The Mallet brothers, Paul and Pierre, crossed Kansas in 1739 as they hoped to establish trade between the French and the Spanish traders from Santa Fe.

For a time, Spain, France and England all had claims on the Kansas area. Nothing was done to establish the English claim and



Source: State Highway Commission of Kansas

Fig. 2. State highway system of Kansas.

in 1763 England gave her claims back to France and forty years later the United States bought from France the Louisiana Territory, which included nearly all that is now Kansas. This transaction changed Kansas from a trading territory into an American settlement with many explorations to follow.

Lieutenant Zebulon Montgomery Pike made a trip into the Kansas area in 1806 in an effort to gain a peace treaty with the Osage and Kansas Indians. During this expedition, Pike persuaded the Pawnee Indians to trade their Spanish flag for the United States flag. It marked the first time the U.S. flag was raised over Kansas territory. Pike continued westward across Kansas territory and discovered the high mountain that is known as Pike's Peak.

Many of the explorers followed the Indian trails leading east and west toward buffalo hunting grounds and rivers. Expansion from that meager trail system later established Kansas as the land of great trails and today as the midway point for modern cross-country transportation. Official recognition of the Santa Fe trail came in 1825 and this great trade route, along with other overland routes passing through the area to the west, opened a whole new era of development for Kansas. Travel and settlement grew along these trails followed by the era of wagon trains, the stagecoach, the pony express, military posts, the transcontinental telegraph, the railroads, and the homesteaders.

Since statehood, the history of Kansas began as the history of the old West. Cattlemen began to drive their tremendous herds to and through famous Kansas cowtowns and the colorful period of the "Wild West" filled those years.

As settlements increased and the railroad stretched even farther across the country, the Indians and buffalo herds disappeared and Kansans settled down to tend their fertile soil. Mennonite immigrants from Russia arrived in Kansas with their famous Red Turkey hard winter wheat which was to help establish Kansas as the wheat state of the nation.

Wheat is often thought of as the most common plant material in Kansas. Grain crops are the basis for the cultural landscape as we use the land today. This functional landscape was the result of geologic and climatic forces creating near level topography and to a climate which favors wheat production on soils which were formed under thousands of years of grass land--the prairie.

Geology of Kansas

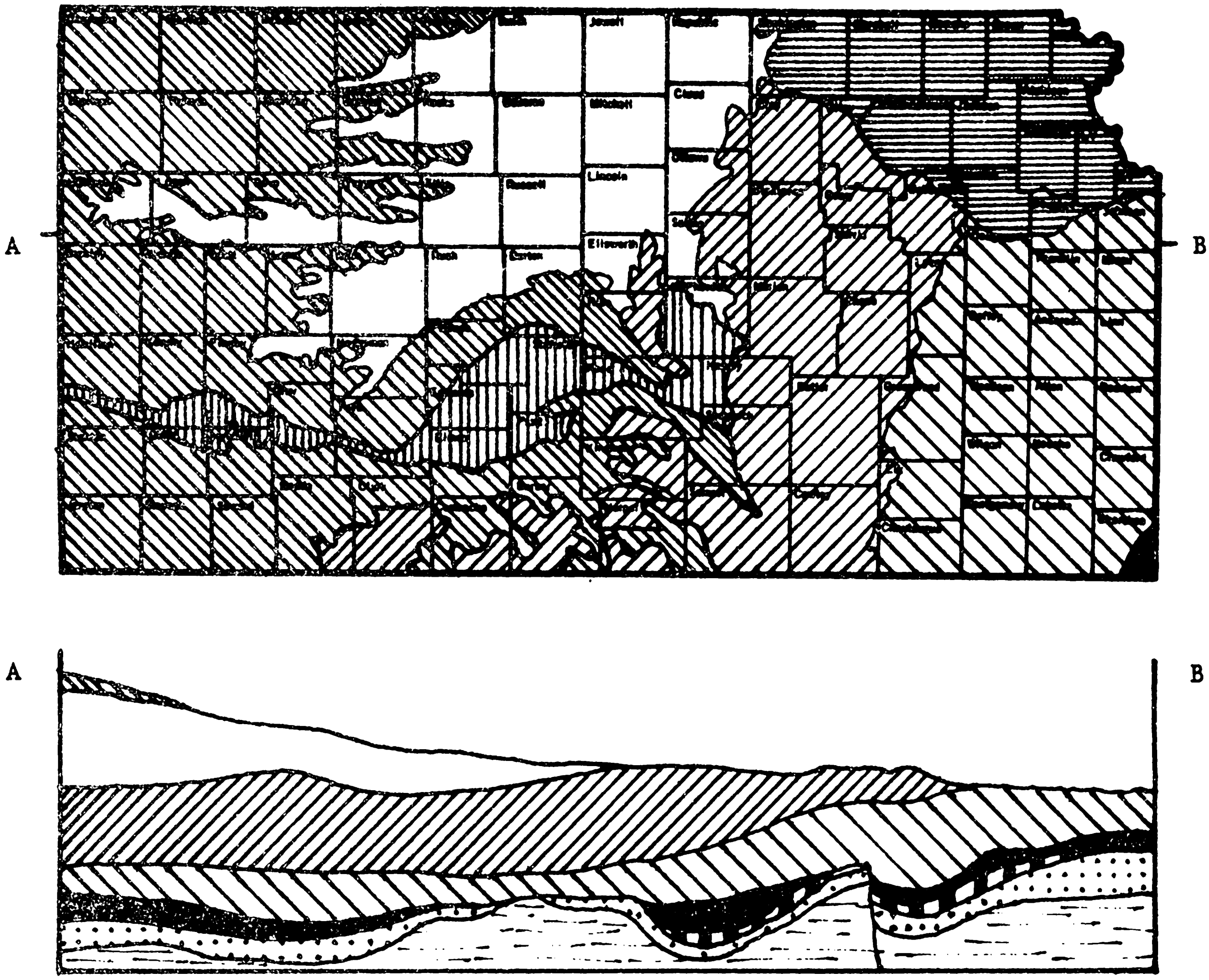
> All things begin with the land, the land is the starting place, it provides the broad forms, the setting. (3-11)

Of course it is not really possible to divide the elements of landscape neatly because each area has generally a characteristic landscape based on its general land form, climate, vegetation and land use. A region's general land form is first expressed through its topography which is strongly influenced by the geology below and near the surface of the land. The landscape designer may only look at the general geologic history of the region he is interested in, in this case Kansas.

The central portion of North America, including Kansas, fluctuated in elevation during the Paleozoic and Mesozoic eras, permitting oceans to spread over the land, covering it with shallow seas. Streams from surrounding highlands and the wave action against the shores deposited layer after layer of mud, silt, sand and lime into the bottom of these seas. These sediments were lithified into rock as the result of cementing action and compaction following deposition. Deep wells drilled in Kansas have penetrated more than 7,000 ft. of sedimentary rock above the Pre-Cambrian granite that underlies the entire state. Thick deposits of Cambrian and Ordovician rocks rest on the Pre-Cambrian rock. These early Paleozoic layers, which may contain oil and gas, are not exposed at the surface in Kansas. Relatively thin layers of Silurian and Devonian occur in the sub-surface of eastern Kansas. The younger rock systems are partially exposed in various parts of the state (Fig. 3).

The landscape in the state is a product of the geological processes operating since the Mississippian period through the Recent stage including glacial material, stream-laid deposits in the valleys and wind-borne deposits on the uplands and valley slopes.

Mississippian rocks are exposed at the surface in southeastern Kansas. These rocks contain lead and zinc in the vicinity of the outcrop area as well as oil and gas further west in the state. Pennsylvanian rocks contain important coal beds that are mined in eastern Kansas and large quantities of oil, gas, limestone, shale clay, pyrite, asphalt rock, and building stone. Permian rocks, the youngest of the Paleozoic system, contain the largest reservoir of natural gas



Source: Kansas Geological Survey, University of Kansas

- Tertiary & Pleistocene
- Pleistocene glacial deposits
- Dune-sand
- Cretaceous
- Permian
- Pennsylvanian
- Mississippian
- Silurian-Devonian
- Cambrian-Ordovician
- Precambrian

Fig. 3. Geology and cross section of Kansas.

in Kansas as well as enormous reserves of salt, gypsum, limestone and building stone. Pennsylvanian and Permian rocks are exposed at the surface in eastern and southern Kansas. Mesozoic rocks of Cretaceous age overlie Paleozoic rocks in north central and northwestern Kansas, and are exposed to the surface in these areas. Important reserves of several grades of clay for pottery, brick, and tile occur in these rocks.

Cenozoic rocks are represented by the younger and more porous Tertiary and Quaternary strata of western Kansas. These rock layers consist mostly of stream-deposited sediments. The youngest deposits laid down during Pleistocene lay over the older rocks on many parts of eastern Kansas, and make up the alluvial fillings of the stream valleys. These deposits contain large quantities of ground water.

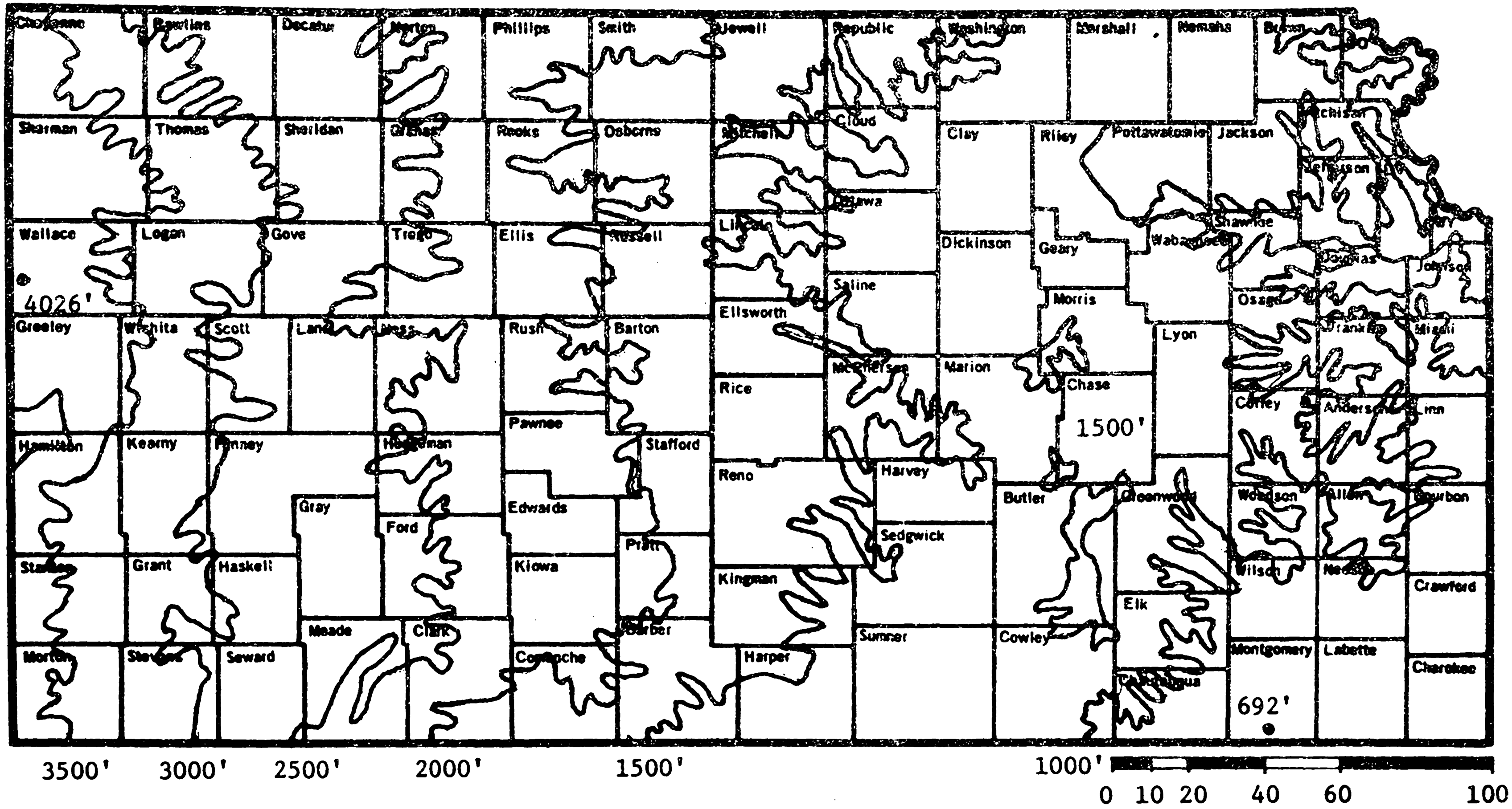
The surface and subsurface geology of the state varies considerably from one area to another because of the past actions of the seas, glaciers and the rivers, which at one time or another exerted their influence on the surface of what is now Kansas.

Physiography of Kansas

Physiographically Kansas is a plain; however one should not think that its surface is everywhere flat and featureless, nor that it is without relief. The landscape of Kansas consists of many hills and picturesque valleys and in places the slopes are very steep. The surface slopes gradually eastward at the rate of 10 to 15 feet per mile. The highest elevation in Kansas, 4,026 ft. above sea level is located on the slightly rolling divide between Goose and Willow creek near the Colorado border in Wallace county. The lowest elevation in the State, slightly less than 700 ft. above sea level, is located in the streambed of the Verdigris river at the Kansas-Oklahoma state line (Fig. 4). Local changes within the state vary greatly, reaching a maximum of about 400 ft. in areas bordering major stream courses, but seldom more than 100 ft. elsewhere. Figure 4 shows generalized topographic elevations of the State in terms of 500 ft. intervals above sea level (35-273).

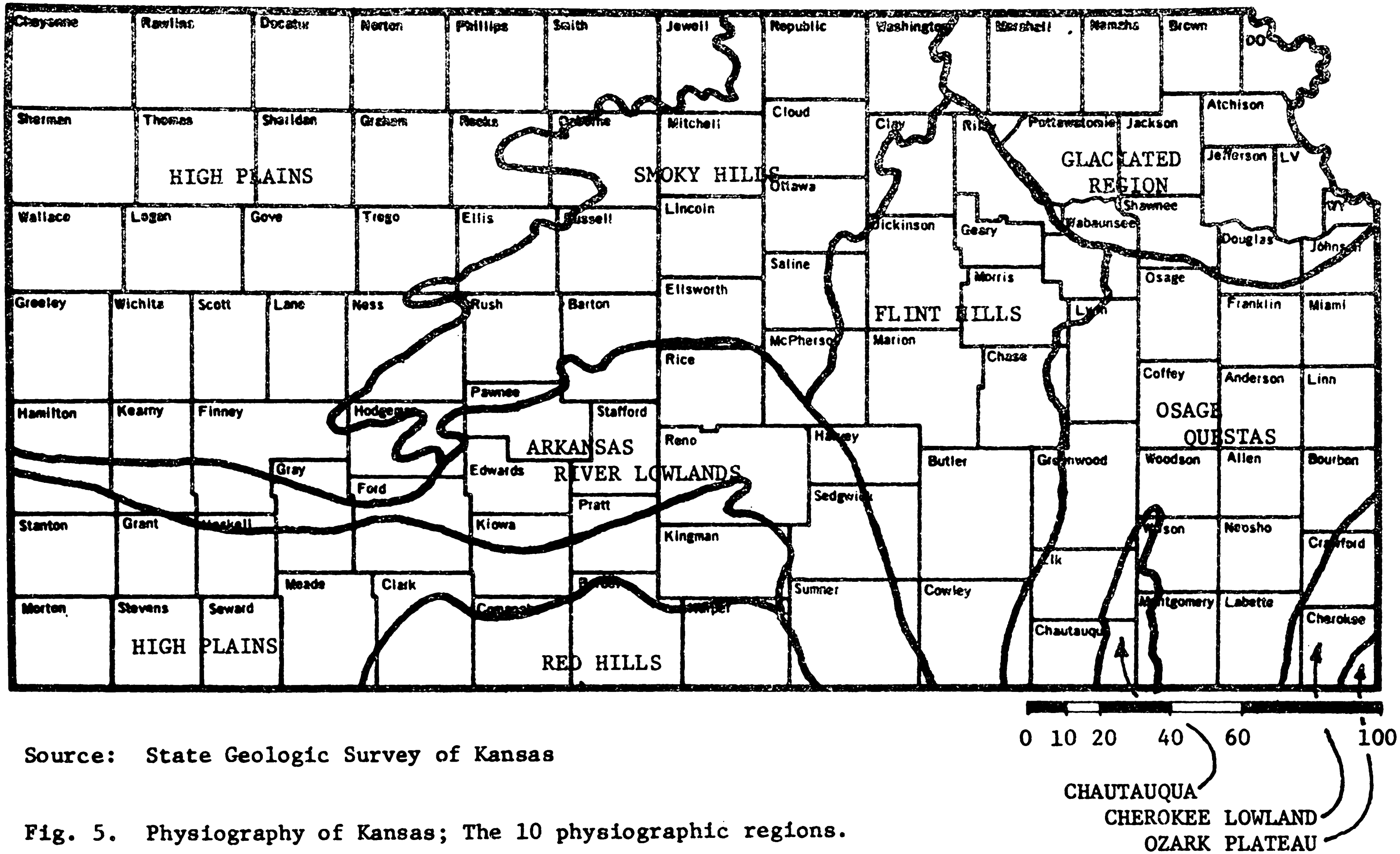
On the basis of the major physical divisions of the United States, Kansas is part of the Interior Plains which is subdivided into the interior low plateaus, Central Lowland and the Great Plains provinces. Only the Central Lowlands and the Great Plains are represented in the State. In general, the eastern one-third of the State belongs to the Central Lowland which in Kansas is divided by the Kansas river into the Dissected Till Plains on the north and the Osage Plains on the south. The western two-thirds of the State lies in the Great Province. Of this province the eastern one-third is called the Dissected High Plains section and the western part is simply called the High Plains. The extreme southeastern corner of Kansas is part of the Ozark Plateau Province which is a part of the Interior Highlands.

The new official 1975-1976 highway map of Kansas recognizes 10 physiographic provinces (Fig. 5). Many man-made changes have occurred during the last 150 years but the physiographic provinces have remained much as they were. These provinces underlie the Kansas landscape which is a subtly changing panorama for those crossing the land forms.



Source: Kansas Water Resource Board, Topeka

Fig. 4. Topography of Kansas.



Source: State Geologic Survey of Kansas

Fig. 5. Physiography of Kansas; The 10 physiographic regions.

Climate of Kansas

> The atmosphere over the land is made visible by the water the air carries. Water in the form of clouds creates the fascinating kaleidoscopic shapes that drift above the landscape. As fog it is the amorphous blanket that lies between hill and trees, obscuring the more distant forms. (3-15)

Kansas has a distinctly continental climate characterized by well defined seasons and rapid changes of weather. Kansas weather is affected mostly by the Rocky mountains to the west and the Gulf of Mexico to the southeast. The mountains decrease the moisture content of air from the Pacific Ocean, while the Gulf is the source of most of the moisture which moves northward over Kansas.

Kansas experiences many extremes of temperature during summer and winter; therefore average weather conditions recorded for Kansas have little meaning. An old farmer from the midwest once said: "Lived here 60 years--never seen an average winter yet!" These extremes include such weather phenomena as high winds, cyclones, tornadoes, hail, frost, blizzards, heat, flood, and last but not least, droughts.

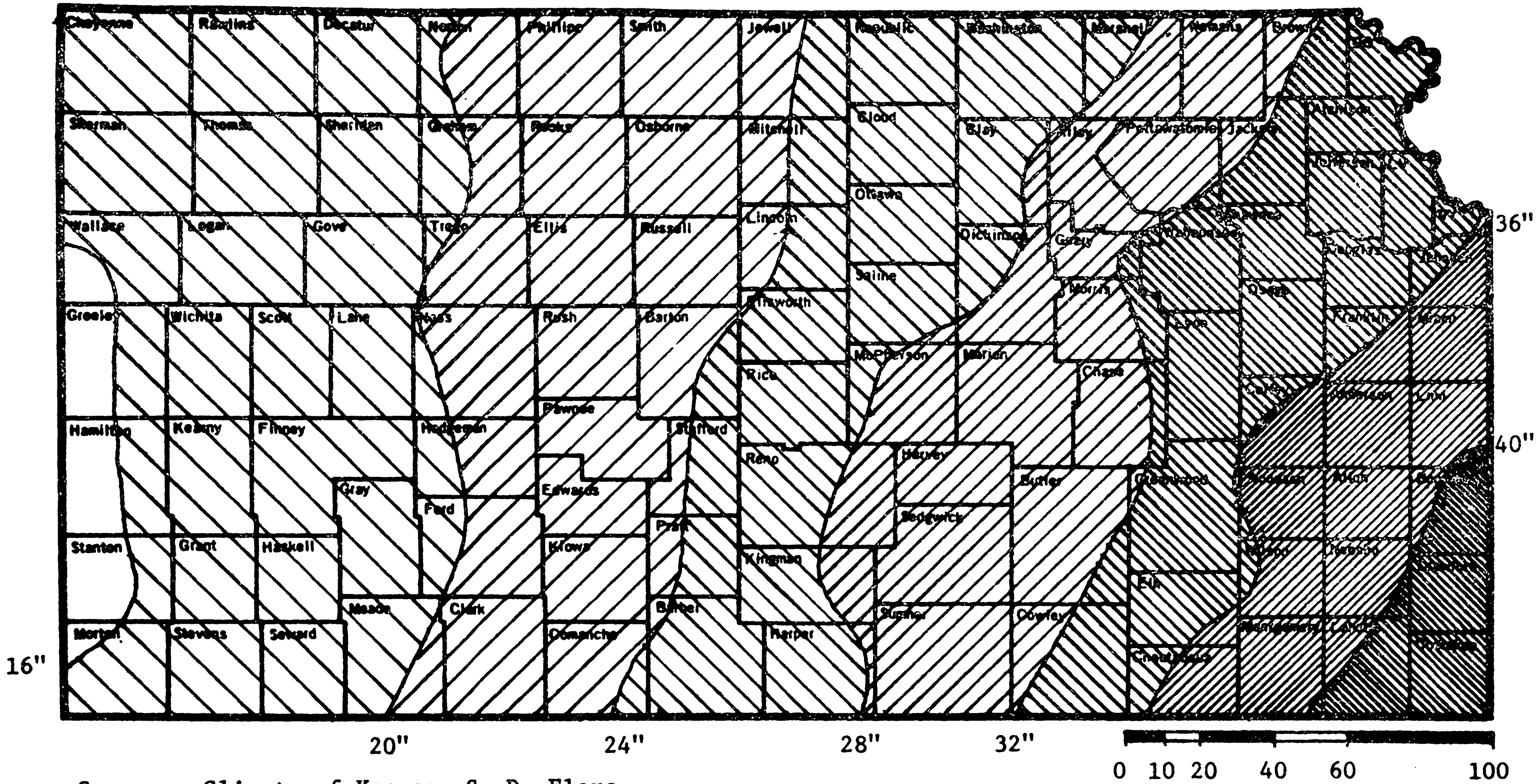
Winters have much sunshine, are mild to cold in temperature, and are the driest time of the year. Marked changes of winter temperatures are frequent.

Spring, with moderate temperatures, many windy days and chance of rainy periods marks the beginning of the long growing season. The summers are sunny and the average temperature is warm to hot. Periods of over 90°F. are a characteristic feature of the summers and temperatures as high as 121°F. have been recorded in the state. Most of the annual precipitation falls during the April to September growing season. May and June commonly receive the highest monthly rainfall during the year, but even during these months, dry periods are not unusual. The autumn generally brings periods of clear cool weather with generally decreasing temperatures and precipitation as the season advances.

Average annual precipitation decreases rather uniformly over the state from 40 inches in the southeast to 16 inches in the west (Fig. 6). Periods of excessive rainfall and periods of drought have been recorded at each of the weather stations in the state.

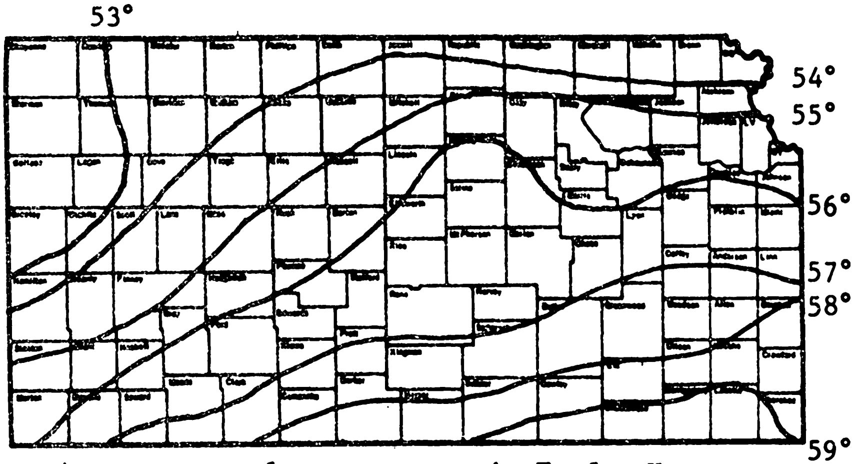
The average annual temperature ranges from about 59°F. along the south central and southeastern border to 52°F. in the extreme northwest (Fig. 7). The winds are generally from a southerly direction most of the year with the exception of the months of December through March, which have winds from the north and northwest a large amount of the time. The western part of the state has the highest wind speeds with an average of about 15 miles per hour. In the eastern part of the state the average wind is 10 miles per hour.

Besides adequate rainfall during the growing season, the length of the actual growing season is of extreme importance for the growth of plants. The low temperature at which vegetation is damaged or destroyed is dependent on a number of weather conditions. While plants may not be damaged, not many grow much at temperatures below 40°F. The length of the freeze-free period for the state varies from slightly over 200 days along the southern border of eastern Kansas to fewer than 150 days in a small portion of northwestern Kansas (37-17). The growing season is the period between the last 32°F. in the spring and the

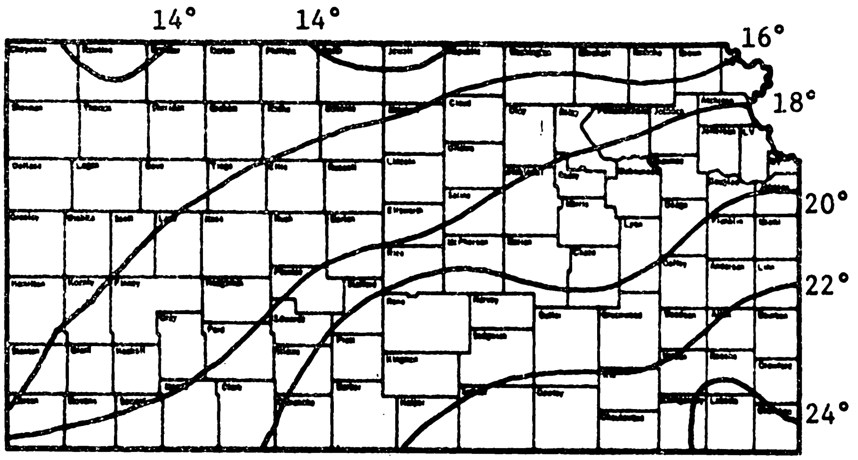


Source: Climate of Kansas, S. D. Flora

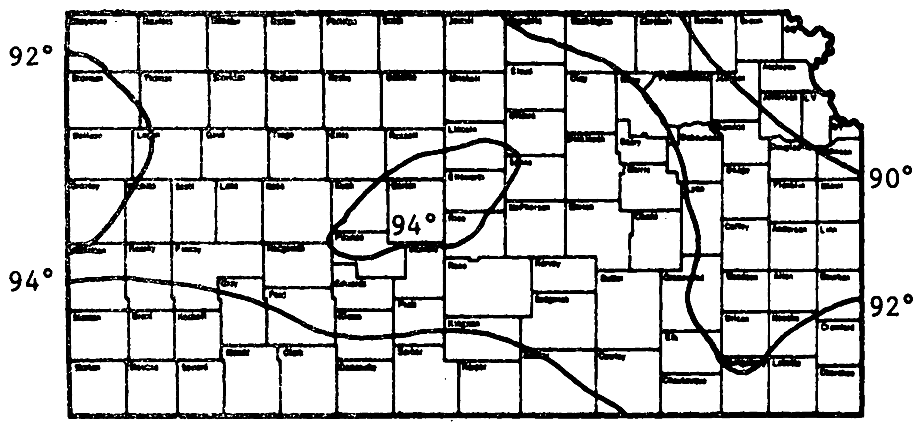
Fig. 6. Average annual precipitation in inches for Kansas.



Average annual temperature in F. for Kansas



Average minimum January temperature in F. for Kansas



Average maximum July temperature in F. for Kansas

Source: Climate of Kansas, S. D. Flora

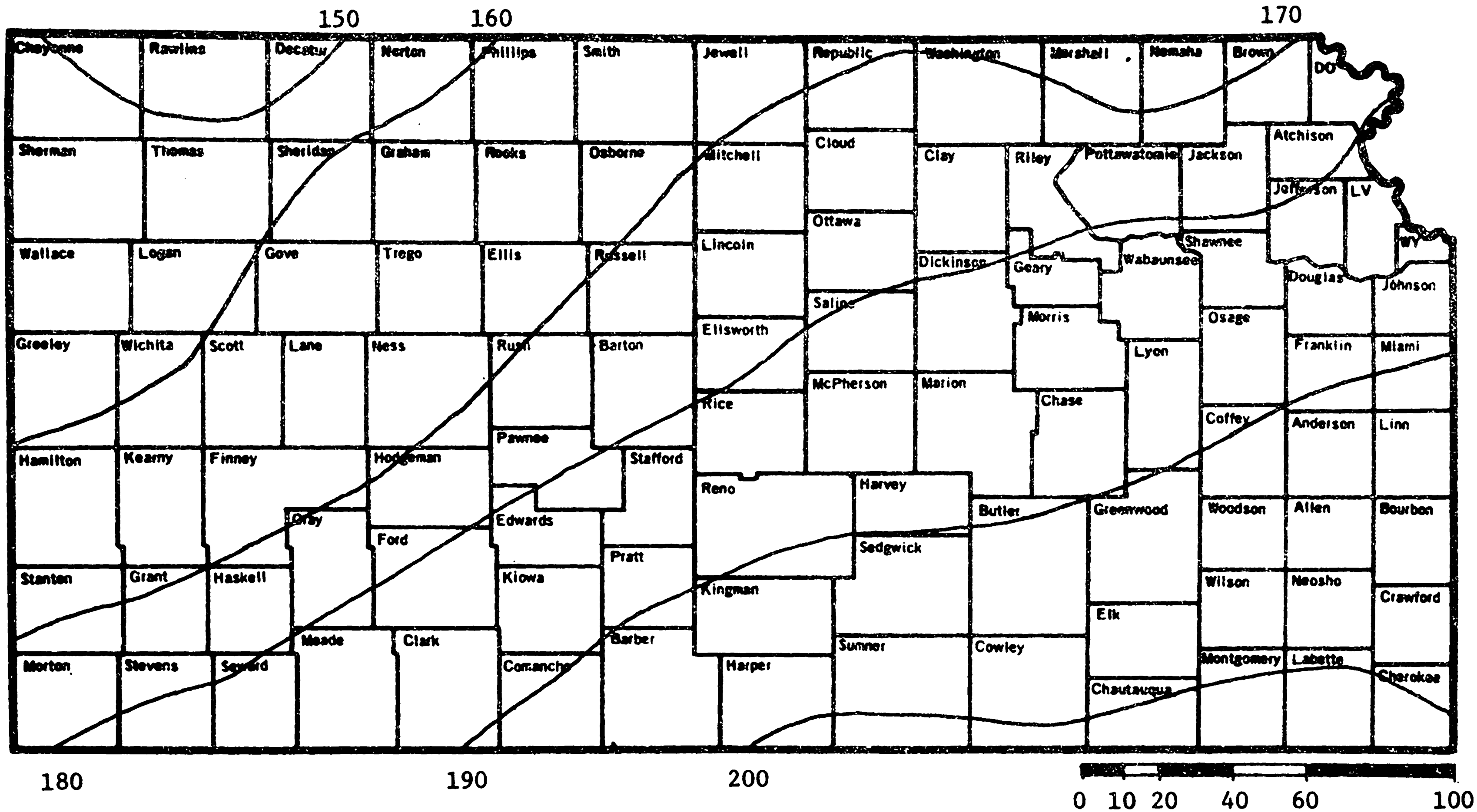
Fig. 7. Average temperature in Kansas.

first 32°F. in the fall and Fig. 8 shows the average freeze free period for the state.

The actual date each year when the last spring and the first fall freeze occurs varies considerably from the average. This variation can lengthen the growing season by as much as four to eight weeks in some years and reduce it by the same number in others. The average data for the last spring freeze represents in Kansas a 50% chance that a freeze will occur either earlier or later than that date in the locality selected.

Droughts: Drought is a recurring problem in Kansas. The condition is created by deficiency of rainfall, usually accompanied by low humidity, hot winds, and high soil temperature. There have been eight exceptionally dry periods in the more than a century since Kansas was settled. These droughts have lasted from only one year during 1901 and 1963 to 10 years from 1930-1940. During the 1930's it was dry except for substantial rains in 1 or 2 months of each year and excess rain in May and June of 1935. The summers of 1934 and 1936 were very hot. The drought from the fifty's lasted from November 1951 through March 1957. This is the most severe drought record because there were so few periods of even normal rainfall to relieve the dry conditions. Drought periods occur most often and are most severe in the western third of the state (37-25).

As an example of the weather extremes I quote from the Kansas Water Atlas:



Source: Agricultural Experiment Station, Manhattan, Kansas

Fig. 8. Average annual growing season in days for Kansas.

> An outstanding example of a thunderstorm occurred at Burlington, Kansas, on May 31 and June 1, 1941 when 12.6 inches of rain were recorded in a 14-hour period. On July 9 through 12, 1951 a four day storm dropped 18 inches of rain. (37-15)

Some temperature extremes, in a few of the hotter summers there have been 50 to 60 days in which a temperature of 100°F. or higher has been experienced in central and south central Kansas. The number of days with zero temperatures or lower, averages 2 to 4 per year in southeastern Kansas and 8 to 10 days in the northwest. The extremes which have been recorded in the state are -40°F. on February 13, 1905, at Lebanon in Smith county and 121°F. on July 18, 1936, at Fredonia and on July 24, 1936, at Alton. Freezing temperatures have been recorded somewhere in the state in every month of the year. The 32°F. reading in July was at Tribune on July 17, 1888, as a result of a very severe hailstorm. On August 26, 1910 an invasion of cold air reduced temperatures to 33°F. at Alton and St. Francis. On that same date, frost occurred at Smith Center, and ice as thick as a window pane was reported by farmers in that area. Temperatures of 100°F. or higher have been experienced in Kansas as early as March 21, 1907 at Ashland, as late as October 9, 1921 at Medicine Lodge (37-16).

Because of these extremes occurring, and a climate with the possibility of recurring droughts, the selection of plant material to provide an attractive landscape must be made with great care. It is one of the main reasons to select from and use native plant materials.

Vegetation of Kansas

> The land, magnificent and varied in its forms, is increased in beauty, diversity, and interest by the flora that covers it. Grasses, ferns, vines, shrubs, and trees of every kind ornament various regions of the land. (3-12)

The natural vegetation of the natural landscape of Kansas was described by George S. Parks in 1854. He traveled up the Kansas river from the Missouri state line and described the vegetation and physiography of the area, now northern Douglas county and adjacent Leavenworth county, while it was still in virtually undisturbed condition. He wrote:

> They saw a bluff with open woods and high rolling prairie in background. On the southside of the river, grass and scattering timber forming a green lawn backed with high prairie. In this neighborhood the shore is rocky. We passed a bald bluff on the north, with a rich bottom on the southside and a high open lawn in the rear. A little farther on, the elevated prairies strike the river, giving a charming variety of scenery, while on the north are extended bottoms of timbered lands.
>
> In this vicinity we saw many Indians along the banks; we also passed a grape thicket in the bottom spread over several thousand acres, while just above, on our right, rose a rocky bluff, covered with open woods. A little above this, Sugar Creek empties into the Kansas, from the right; and a little farther up, there is a low bluff, a short distance beyond there being another fine grape thicket, and with walnut bottom. On the right side of the river rises a beautiful undulating eminence of open woods and a fine prairie about a mile back.
>
> On the left, a short distance above, the Wakarusa flows in--a considerable stream--with good timber for some way back.
>
> On both sides of the river, above the Wakarusa, there are excellent bottom lands;--farther up on the south bank, the high prairie comes down to the water's edge--away as far as the eye could reach in south west direction, the prairies were high and rolling, like the waves of old ocean--southward, beautiful groves dot the prairie and the dark line of timber that stretches along the Wakarusa Valley, with the great prairie mound fixed there as a landmark of perpetual beauty--the meandering river with its dark skirting forests of timber

> on the north.--Proceeding north, high rich bottoms extend for many miles and we saw vast thickets of grape-vines, pea-vines and paw-paws. The timber was principally oak, walnut, ash, hickory, mullberry, hackberry, linden, cottonwood and coffee-bean. (43-441,442)

George Parks' description of the landscape along the Kansas river gives the feeling of an abundance of plant material. This is true because he was traveling along the river corridor where ample water and protection from fire encouraged trees, shrubs and vines to grow. But beyond the banks he saw the high prairie, and Kansas was, and still is primarily a prairie state. In its pristine state the prairie was grazed by roaming herbivores, which in turn were preyed upon by wolves, cougars, and other predators. Lightning fires occasionally swept across vast expanses with no one to put them out. This resulted in controlling and preventing expansion of trees. The prairie crosses Kansas from east to west in three broad zones. In the east the tall grasses and many forbes prevail. In the west short grasses prevail and in between them lies the mixed prairie.

In the most eastern parts of Kansas the precipitation is adequate for upland forests. The southeastern part originally contained some fine stands of hard woods, which were used liberally by the early settlers. These trees were found in protected ravines, on sandy hills and along stream courses. From east to west the broadleaf decidious trees become more and more closely confined to river valleys and stream banks, until along the western boundary only smaller trees are found with some cottonwoods (Fig. 9).

A forest survey, made in 1937 indicated that the eastern third of the state contains 75 percent of the naturally forested area, the

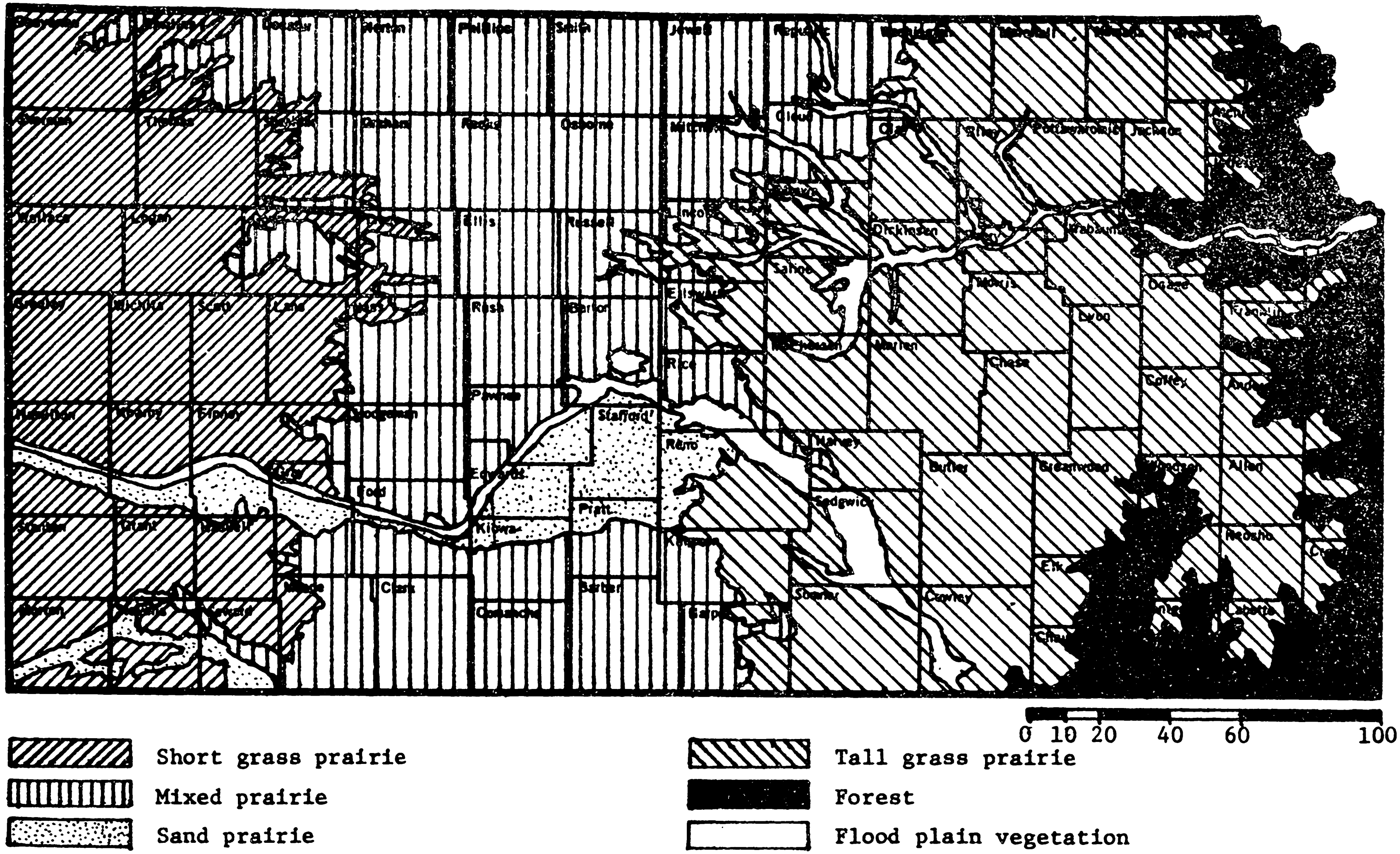


Fig. 9. Natural vegetation of Kansas.

Source: The Potential Natural Vegetation of Kansas, A. W. Kuchler central third 21 percent and the western third 4 percent. The 100th meridian has been regarded as the line beyond which trees are very difficult to grow. Moisture is the chief factor determining the occurrence of the natural forest. In the days before white settlement, natural forest covered an estimated 4,480,000 acres or 8.5 percent of Kansas present land area. Today this is 1,500,000 acres or 3.3 percent (Fig. 10).

In any landscape one of the most significant features is the vegetation; it has been defined as the mosaic of plant communities (29-586). A plant community generally consists of many growth forms such as trees, shrubs, grasses, forbes and others. The structure of the plant community is the spatial distribution pattern of the growth forms. An appreciation of present and past plant communities can help one with the selection of adapted plant material and with landscaping on a small and regional scale.

Vegetation Boundaries: The dynamism of the Kansas vegetation and the character of particular vegetation types must not be ignored. Vegetation types which owe their extent primarily to edaphic conditions have a fixed location. By contrast the mixed prairie is very sensitive to the major fluctuations of precipitation, oscillating eastward and westward with the alternating intense droughts and wet periods. The border between the grama-buffalo prairie and the mixed prairie is strongly effected by topography. The grama-buffalo grass prairie is found on the smooth uplands while the mixed prairie extends far westward on the steep slopes of stream dissection.

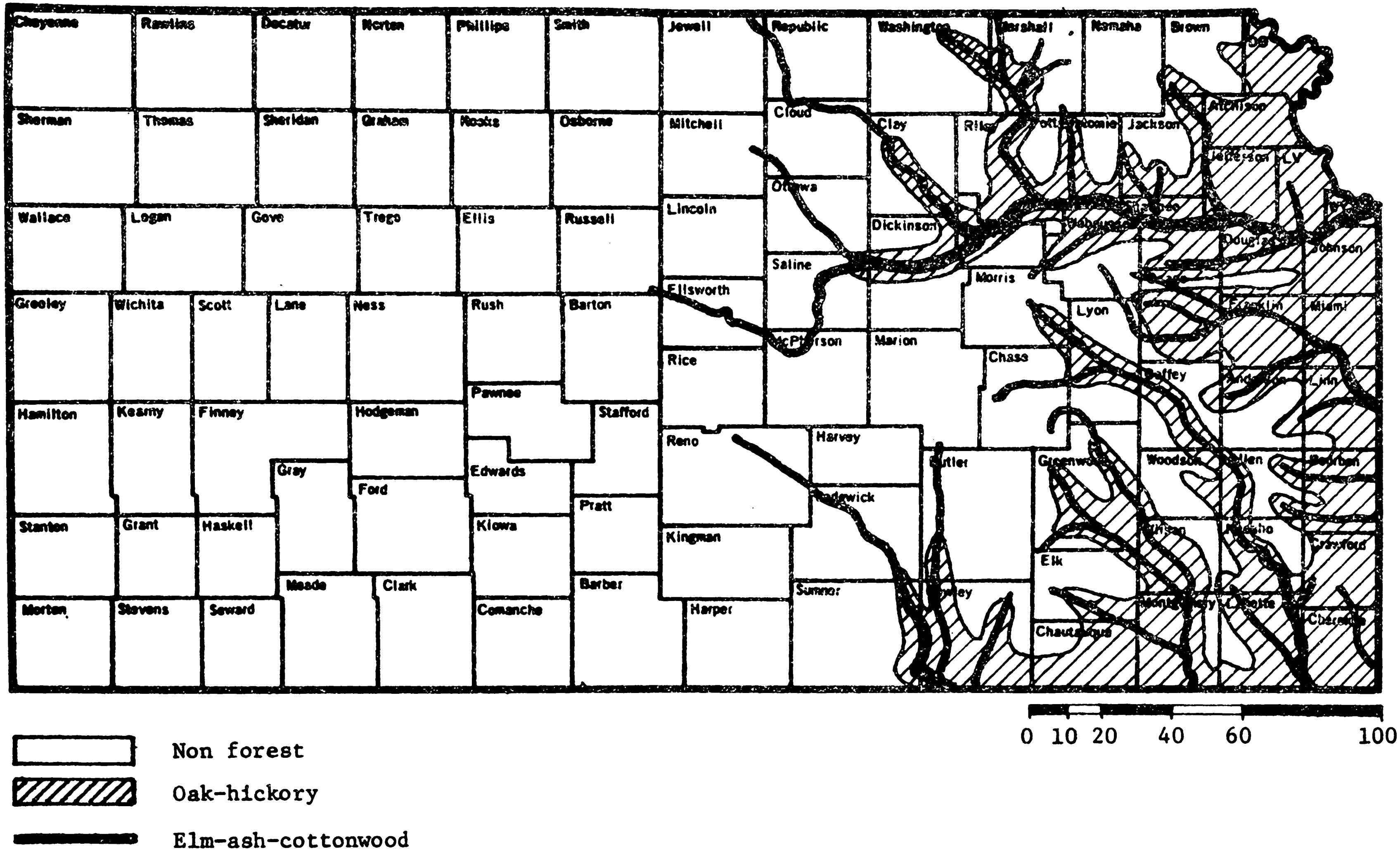


Fig. 10. Forest type groups of Kansas. Source: North Central Forest Experiment Station

The boundaries of the bluestem prairie are vague; the prairie forest border is dissolved into a mosaic in which the species of one type are not mixed with those of the other, and each of the two vegetation types involved retains its discrete character. The oak-hickory forest does not gradually open up into a savanna but keeps its identity. The bluestem prairie does likewise. Consequently in easternmost Kansas forests with islands of prairie gradually change westward into a forest prairie mosaic and finally into prairie with forest islands. There is a transition between the mixed prairie and the bluestem prairie. In contrast to the mosaics the growths forms and taxa of both prairie types are well represented. Generally the bluestem prairie is limited to the lower parts of the ravines.

In Kansas the vegetation boundaries are found to be in some places very clear and abrupt and elsewhere rather indistinct (46-586-604).

Regional Development

In regional landscaping there is not yet a generally accepted approach to the treatment of the countryside as a whole. Most likely this is the consequence of an insufficient understanding of the character of our rural environment. Too many people still want to consider the landscape in its present form as a stable phenomenon in a changing world. But they forget that change has always been inherent to the countryside and that nearly all the features which attract us today are created, shaped, or influenced by man.

In the past this creative attitude has enriched many countries with a diversified scenery and it is certainly necessary to preserve the most valuable examples of such historic environments. They belong to our cultural heritage just as the historic areas of older cities, and the treasures collected in our national galleries, belong in other cultural landscapes. The prairie is the treasure of Kansas. A more detailed analysis of each of the ten major physiographic regions in Kansas will help with appreciating and understanding regional landscape character and selection of native plant material as a basis for a functional regional landscape development.

A. Ozark Plateau:

The Ozark Plateau is found in the southeast corner of the state and covers an approximate 50 square mile area east of Baxter Springs and south of Galena (Fig. 5). Here great thicknesses of flinty limestone occur as bedrock. Stream erosion and further weathering of the thick limestone produced the typical terrain of the Ozarks. The rolling terrain slopes gradually to the west. Noticeable for the region are some tall chat piles which are the result of the lead and zinc mines found there. The age of the rock is Mississippian and the rock layers consist of cherty limestone and shale.

The soils of the Ozark Plateau are lightly colored soils, developed under forest vegetation, Gray-Brown-Podzolic and formed the Baxter-Eldon-Nixa association. These soils form a rolling landscape, well drained, with light brown and dark brown, cherty silt loam surfaces and strong silty clay loam subsoils. They were developed

Fig. 11. OZARK PLATEAU - Noticeable for this region's landscape are tall chat piles which are the result of the lead and zinc mines found here.

Fig. 12. OZARK PLATEAU - Chat piles can be undesirable elements in the landscape by reason of their bulk, their height, their hard lines, or their color.

Fig. 13. OZARK PLATEAU - A chat pile can become a welcome landmark by halving the height and softening the shape into more natural looking contours. Add natural vegetation and allow the quarry to fill with water and a new attractive landscape element has been created.

Fig. 14. OZARK PLATEAU - Stream erosion showing flinty limestone bedrock and native vegetation. Here grows the flowering dogwood, Cornus florida.

under cherty limestone. Stones comprise 25% to 50% of the soil mass, except in the Nixa soils which are usually stone free. Some slopes of Eldon and Baxter are not arable because of stones. The soils are medium in fertility and the stone areas are droughty. Agriculture consists of dairy, fruit, and general farming (1-95).

The new soil classification system describes these soils as Typic Udults, suborder Udults. Soils are deep brown cherty silt loams.

The average annual precipitation is 40 inches or more.

The potential natural vegetation is oak-hickory forest as a medium tall deciduous forest with islands of bluestem prairie. Dominant species are bitternut hickory (Caraya cordiformis); shagbark hickory (Caraya ovata); white oak (Quercus alba) and Shumard's oak (Quercus shumardii). Other characteristic components are Cornus florida, Forestiera acuminata; Fraxinus americana, Ilex decidua, Juglans nigra, Prunus serotina, Quercus muehlenbergii, Vaccinium stamineum (22-599).

B. Cherokee Lowland:

The Cherokee Lowland comprises approximately 1000 square miles (Fig. 5). These lowlands are an erosional plain of which the surface slopes west at an average rate of 10 feet per mile. It developed upon the shales and sandstones which range in thickness at the outcrop from 400 to 600 feet. The Cherokee shale is the lowermost unit of the Pennsylvanian System of rocks in the state (35-281). The surface is gently undulating except for a few erosional remnants, which are capped by resistant sandstone. The valleys are wide, shallow, and flat bottomed. The Neosho, Drywood creek and Spring rivers drain the Cherokee Lowlands.

The oldest Pennsylvanian sediments are characterized by many thin beds of coal which used to be mined underground, however, underground mining is no longer carried out in Kansas, stripmining has taken its place with the resulting landscape of furrows and ridges.

The soils have dense clayey subsoils. The Great Soil Group is the planosol and the soil associations are Oswego and Parsons. Oswego is identified with very gently rolling areas consisting primarily of Oswego silt loam which has a dark brown surface and a plastic clay subsoil, mottled yellow and grey in the lower portion. This soil has developed from shale. Associated soils are Woodson, which has a black clay loam surface and was derived from calcareous shales and Bates, which has a dark brown loam surface and was formed from sandstone and shale. These are productive soils. They are used for general grain and livestock farming. The low organic matter content and frequent late summer droughts limit production (1-112). Parsons soils occur on nearly level to gently sloping topography and are moderately well drained. They have grayish brown, acid, silt loam or loam surfaces and grayish brown claypan subsoils. They too have developed from shale. The Parsons soils are not as dark on the surface and are more mottled in the subsoil than the Oswego soils. The agriculture is general grain and livestock farming. Moderately low fertility and moderate acidity are the main management problems. During wet springs there is slow subsoils permeability.

The new classification system describes these soils as Udolls, Aquols and Aqualfs, which are deep to moderately deep, very dark greyish brown and black silt loams, clay loams and silty clay loams.

The average annual precipitation is 40 inches or more.

The potential natural vegetation for the Cherokee Lowland region is bluestem prairie, dense stands of tall and medium tall graminoids. Shorter grasses are significant only along the western part of this region. Forbs vary in height from low to very tall, they are numerous, and can produce strong seasonal aspects. Dominant species are big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), switch grass (Panicum virgatum), Indian grass (Sorghastrum nutans). Other characteristic components are: Amorpha canescens, Antennaria neglecta, Asclepias tuberosa, Aster ericoides, Aster laevis, Baptisia leucantha, Baptisia leucophaea, Bouteloua curtipendula, Caenothus ovatus, Elymus canadensis, Erigeron strigosus, Galium tinctorium, Helianthus grosserratus, Koeleria cristata, Lespedeza capitata; Liatris hirsuta, Liatris mucronata, Liatris punctata, Liatris scariosa, Lithospernum incisum, Panicum scribnerianum, Petalostemum purpureum, Psoralea argophylla, Psoralea floribunda, Ratibida columnifera, Ratibida pinnata, Rosa suffulta, Silphium laciniatum, Solidago altissima, Solidago missouriensis, Solidago rigida, Sporobolus asper, Sporobolus heterolepsis, Stipa spartea, Viola pedatifida (22-597).

These plants are found mainly on the uplands throughout eastern Kansas and they may extend far westward on the flood plains of rivers and streams.

Fig. 15. CHERROKEE LOWLAND - Rt. #66 dips down into the Cherokee Lowlands. Deciduous trees grow on the hills.

Fig. 16. CHEROKEE LOWLAND - The surface is gently undulating---

Fig. 17. CHEROKEE LOWLAND - ---except for a few erosional remnants, which are capped by erosion resistant sandstone. On the ridge grow hackberry, oak, elm, hard maple and other species.

Fig. 18. CHEROKEE LOWLAND - Road cut along Rt. 26 showing erosion resisting sandstone.

Fig. 19. CHEROKEE LOWLAND - The Cow creek showing the shallow depth of many of the mid western streams. Cottonwood, peachleaved and black willow are dominant species growing along the stream.

Other potential plant material important to the Cherokee region is found along the rivers as flood plain forest and savanna. Here are found medium tall to tall broadleaf deciduous forests often with dense undergrowth and many lianas. The forests become narrower and lower westward and often less dense.

Dominant species are hackberry (Celtis occidentalis), cottonwood (Populus deltoides), peach-leaved willow (Salix amygdaloides), black willow (Salix nigra), American elm (Ulmus americana). Other characteristic components are Acer negundo, Acer saccharinum, Celastrus scandens, Elymus virginicus, Fraxinus americana, Fraxinus pennsylvanica, Gleditsia triacanthos, Gymnocladus dioica, Juglans nigra, Helianthus annuus, Morus rubra, Parthenocissus quinque-folia, Phlox divaricata, Platanus occidentalis, Polygonum persicaria, Polygonum punctatum, Quercus macrocarpa, Rhus radicans, Salix interior, Senecio glabellus, Smilax hispida, Symphoricarpos orbiculatus, Tamarix gallica, Ulmus rubra, Urtica procera, Vitis riparia (22-601).

These plants can be found throughout Kansas along flood plains and streambanks wherever seepage water from permanent or intermittent streams is available, but the number of species declines markedly from east to west.

C. <u>Chautauqua Hills</u>:

The Chautauqua Hills include a triangular belt approximately 10 miles wide (Fig. 5). These hills are developed by rock of Pennsylvanian age. Thick sandstones which farther north are replaced by shales and which there, because of their position between the limestones, produce escarpments. As a result of erosion in the sandstone belt the surface has been dissected into a series or range of low hills which are characteristically covered by growth of Jack oaks and post oaks with redbuds along the sides. The region is intersected by many deep-valleyed small streams, such as Verdigris, Fall and Elk rivers. The relief of the Chautauqua Hills is nowhere greater than 250 feet (35-281).

The light colored soils developed under forest vegetation, they are Gray-brown Podzolic and Red-yellow Podzolic. The association is Darnell Stephenville. The landscape is undulating to rolling with well drained to excessively drained soils with grayish-brown and brown, acid, fine sandy loam or silt loam surfaces. They were developed from the sandstone and shale. These soils are inherently low in fertility, but crops respond well to good management. The steep slopes are chiefly in woods and brush, with some pasture. The prevailing use is for livestock farming. The stream valleys are used for growing crops.

The new classification system describes these soils as Ocrepts, Udolls and Ustalfs. They are moderately deep, very dark grayish brown clay loams and shallow and moderately deep dark brown fine sandy loams and cobbly fine sandy loams.

The average annual precipitation ranges from 32 inches along the western boundary to 40 inches along the east.

The potential natural vegetation is oak and bluegrass and a medium tall, rather dense stand of graminoids with low broadleaf deciduous trees scattered singly or in groves of varying sizes. The groves are

Fig. 20. CHAUTAUQUA - As a result of erosion the surface has been dissected into a series of low hills which are characteristically covered by growth of Jack oaks and post oaks with redbuds along the sides. Rt. 96 north of Independence.

Fig. 21. CHAUTAUQUA - A road cut along Rt. 96 north showing light colored soil and shale deposits with sandstone capping.

Fig. 22. CHAUTAUQUA - A wide valley through which the Verdigris river runs, east of Independence. On the right road bank introduced plant material, scotch pine, which is adapted to Kansas. On the left side of the road a large native sycamore.

Fig. 23. CHAUTAUQUA - Typical escarpment of the Chautauqua region with Jack oaks and post oaks growing along the ridge.

Fig. 24. CHAUTAUQUA - Post oak growing in dense groves.

often open permitting a grass cover on the forest floor (22-599). Dominant species are big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), blackjack oak (Quercus marilandica) and post oak (Quercus stellata). The shallower the soil the more blackjack oak prevails over post oak. Other characteristic components are: Amorpha canescens, Antennaria neglecta, Aster ericoides, Aster leavis, Baptisia leucantha, Baptisia leucophaea, Bouteloua curtipendula, Bouteloua hirsuta, Celtis occidentalis, Elymus canadensis, Eragrostis spectabilis, Eragrostis trichosus, Erigeron strigosus, Galium tinctorium, Helianthus grosserratus, Kouleria cristata, Liatris hirsuta, Liatris scariosa, Panicum scribnerianum, Panicum virgatum, Phlox pilosa, Psoralea argophylla, psoralea floribunda, Quercus velutina, Ratibida columnifera, Ratibida pinnata, Rhus copallina, Rosa suffulta, Silphium laciniatum, Solidago altissima, Solidago missouriensis, Solidago rigida, Sorghastrum nutans, Sporobulus asper (22-599).

Along the flood plains the same plant material can be found as along the Cherokee lowlands.

D. <u>Osage Cuestas</u>:

The Osage Cuestas comprise essentially all of eastern Kansas, south of the Kansas river and as far west as Manhattan in Riley county (Fig. 5). In general the Osage Cuestas consist of a series of northeast-southwest irregularly formed east facing escarpments between which are flat to gently rolling plains. The underlying strata are made up of unequally resistant alternating hard and soft Pennsylvanian formations of limestone and shale which are gently inclined to the west and northwest (1-282).

The escarpments range in height from 50 feet or less to more than 200 feet. The major streams, the Neosho and Verdigris rivers, flow in a general east and southeast direction, transverse to the direction of the escarpments, and against the dip of the rock formations. These streams flow in valleys from one to several miles wide, with their flood plains from 100 to 200 feet below cuesta tops (1-286).

The soils belong to two great soil groups. These are the dark colored soils developed under prairie vegetation; along the western boundary are immature and shallow soils on steep slopes. The first are the Brunizem and Humic-gley soils with Summit, Woodson and Labette association, the second is the Sogn-Florence association.

The Summit-Woodson-Labette is described as being very gently sloping and well drained. The soils have very dark grayish brown moderately acid silty clay loam surfaces and clay subsoils. They were developed from limestone and shale residuum. Labette soils have reddish brown silty clay subsoils. The soils respond to good management which include liming, fertilizer application, and erosion control. Occasional late summer droughts impair the production of bluegrass pastures (1-76).

The Sogn-Florence association is a steep to undulating landscape with excessively drained Regosols or Lithosols intergrading to Rendzinos on the steep slopes, and well drained reddish prairie soils. They have very dark grayish brown, acid, stony, and cherty clay loam surfaces, and are underlain at shallow depths by weathered and unweathered consolidated shales and limestones. Grazing is carried out on the bluestem prairie and crop production on the broad divides and in the stream valleys.

The new soil classification system describes the soils as Udolls, Agnolls and Aqualfs, which are the same as for Cherokee Lowlands. Along the west it describes the soil as Ustolls, which are deep dark grayish brown and brown fine sandy loams, loams and silt loams.

The average annual rainfall for this region ranges from 32-40 inches.

The potential natural vegetation is as for the Cherokee Lowlands with in addition along the eastern fringe an intermixing with oak-hickory forest, a medium tall multilayered broadleaf deciduous forest. Dominant species mixed with the previously mentioned dominants are: bitternut hickory (Caraya cordiformis), shagbark hickory (Caraya ovata), white oak (Quercus alba), red oak (Quercus borealis), black oak (Quercus velutina). Other characteristic components are: Aesculus glabra, Asimina triloba, Cypripedium calecolus, Fraxinus americana, Hydrophyllum appendiculatum, Juglans nigra, Ostrya virginiana, Phlox divaricata, Padophyllum peltatum, Prunus serotina, Quercus macrocarpa, Quercus muehlenbergii, Ribes missouriense, Rhus radicans, Sarquinaria canadensis, Staphylea trifoha, Tilia americana, Ulmus americana.

Along the streams on the floodplains the same vegetation is found as along the streams running through Cherokee Lowlands (22-599).

Fig. 25. OSAGE CUESTAS - The Osage Cuestas are made up of a series of irregularly formed east facing escarpments, in between are flat to gently rolling plains.

Fig. 26. OSAGE CUESTAS - Low escarpment with a river bottom growing alfalfa for hay. Note the deep green color in the landscape of this cultivated crop.

Fig. 27. OSAGE CUESTAS - Prairie hay, small round bales (live-savers) dotting the gently sloping uplands. Prairie grasses, which once fed the buffalo now feed the beef herds. Agriculture provides an interesting land surface.

Fig. 28. OSAGE CUESTAS - Three cottonwoods growing in an erosion gully help to create a functional landscape. They help control further erosion, provide shade for livestock and add a point of interest along the road in an otherwise treeless space.

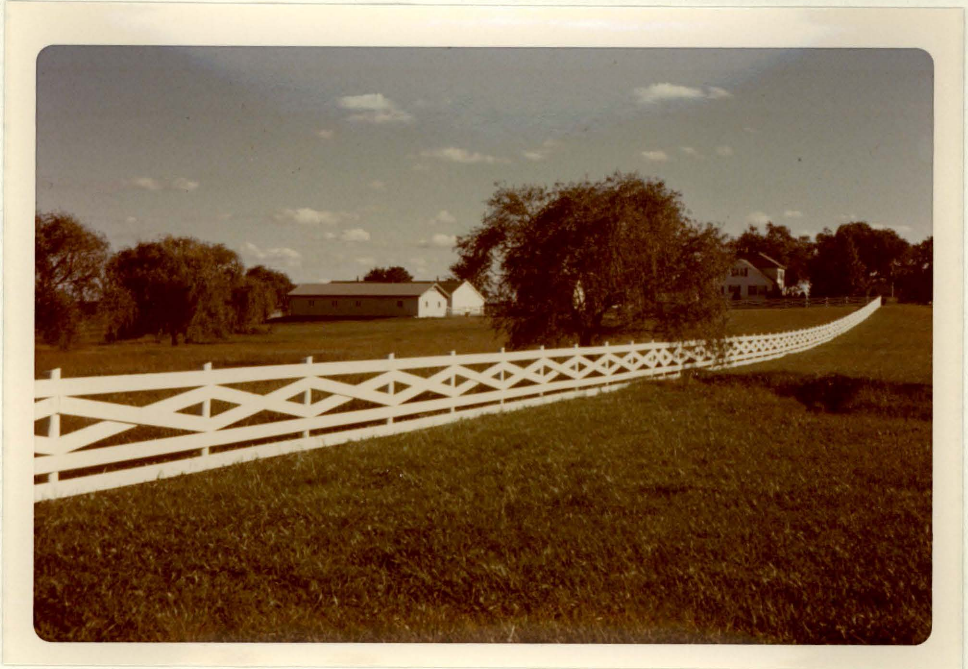


Fig. 29. OSAGE CUESTAS - An elaborate farm fence along Rt. 59 showing attractive agricultural landscape. Home and barns are tied together by well grown trees. Ample shade is provided for livestock.

Fig. 30. OSAGE CUESTAS - Native vegetation--a medium tall multi layered broad leaf deciduous forest with sumac providing deep red fall color in foreground.

E. Glaciated Region:

The Glaciated Region lies north of the Kansas river and is really a northward extension of the Osage Cuestas because the underlying rock of both areas is identical (Fig. 5). The difference is that the former have been glaciated and the latter not. A cover of drift material due to at least two ice invasions covers much of the type of topography found in the Osage Cuesta's south. Typical rock controlled topography is absent in the Glaciated Region except near its southern margin close to the valley of the Kansas river and on the west along the Big Blue river. The topography is an erosional drift-controlled surface which in general may be described as gently undulating. Inter-stream areas away from major drainage lines are smooth, broad, and well rounded, and are the remnants of the original uneroded ground moraine topography left on the retreat of the ice. Closer to larger streams the landscape becomes more dissected with gentle slopes and wide open valleys. Adjacent to the larger streams the country is highly dissected into a rough and hilly region. The river bluffs in many instances are too rough for cultivation, and reveal in their steep walls, layers of limestone shale and some sandstone. The hilliest and roughest portion of this region lies in a strip of several miles wide following the Missouri river. This strip has been called "Little Switzerland." Relief ranges here from 50 to 300 feet along the narrow winding ridges with steep walled ravines and valleys.

The Glaciated Region comprises the richest agricultural part of eastern Kansas.

The major soil group is Brunizem and Humic-Gley. The soil associations are from a narrow belt following the Missouri river west in three successive stages: Monona-Ida-Hamburg; Shapsburg-Pawnee-Grundy-Burchard.

The Monona-Ida-Hamburg are hilly, well drained areas. The soils have moderately dark colored silty surfaces and were formed from thick loess deposits. The slightly acid Monona occurs in the narrow upland divides, while eroded Monona and calcareous Ida soils are found on the steeper slopes. The regosolic Hamburg soils occur on the steep bluffs near the Missouri river bottomlands. The upland soils are responsive to good management though somewhat droughty. Sheet and gully erosion are serious problems. Level terraces and contour listing are effective soil and water conservation measures (1-72).

Sharpsburg-Marshall-Burchard are undulating to rolling well drained areas. The soils have dark grayish brown, acid, silty clay loam surfaces that grade with depth into finer silty clay loam. The Sharpsburg and Marshall soils developed from calcareous loess, the Burchard soil developed from glacial till. The soils are naturally fertile and respond to good management which should include erosion control (1-75).

Pawnee-Grundy-Burchard are undulating and rolling to nearly level, moderately well drained to well drained soils, with very dark grayish brown, acid silty clay loam surfaces and clayey subsoils. The Pawnee and Burchard soils developed from glacial till. The Grundy soil was developed from calcareous loess. Problems are erosion control, slow subsoil permeability and soil acidity. Excessive rainfall or

Fig. 31. GLACIATED REGION - The topography is an erosional drift-controlled surface which in general may be described as gently undulating. The wheat crop on top of the ridge is sown on the contour--a beautiful expression of culture in agriculture and an interesting variation where generally the straight lines of the grid are followed.

Fig. 32. GLACIATED REGION - Close to the larger river, the Missouri, the landscape becomes more dissected with gentle slopes and wide open valleys.

Fig. 33. GLACIATED REGION - A short distance away from the larger streams the country is highly dissected into a rough and hilly region.

Fig. 34. GLACIATED REGION - The river bluffs in many instances are too rough for cultivation and reveal in their steep walls layers of limestone, shale and some sandstone.

Fig. 35. GLACIATED REGION - The hilliest and roughest portion of this region has been called "Little Switzerland."

Fig. 36. GLACIATED REGION - We need to pay attention to the style of new structures, but even more attention should be paid to some of our older structures which help to give the rural landscape a character, in particular our farm buildings.

Sloane would say "this barn is in a state of pleasing decay" (39-13).

prolonged drought may limit crop yields. General crop and livestock farming is followed (1-76).

The new soil classification system describes the soils as Udolls, Udalfs and Ustolls. They are deep and shallow, black and very dark silty loams, clay loams, and silty clay loams.

The average annual rainfall for this region ranges from 28 to 38 inches.

The potential natural vegetation is as for the Osage Cuestas with along the Missouri river uplands the oak-hickory forest association, which is a medium tall multilayered broadleaf deciduous forest. Dominant species are: bitternut hickory (Caraya cordiformis), shagbark hickory (Caraya ovata), white oak (Quercus alba), red oak (Quercus borealis), black oak (Quercus velutina). Other characteristic components are Aesculus glabra, Asimina triloba, Cypripedium calceolus, Fraxinus americana, Hydrophyllum appendiculatum, Juglans nigra, Ostrya virginiana, Phlox divaricata, Podophyllum peltatum, Prunus serotina, Quercus macrocarpa, Quercus muehlenbergii, Ribes missouriensis, Rhus radicans, Sanguinaria canadensis, Staphylea trifolia, Tilia americana, Ulmus americana (22-599).

F. Flint Hills:

The Flint Hills uplands stretch across nearly the width of Kansas along the western boundary of the Osage Cuestas. The limits are defined by the outcrops of flint bearing Permian Strata (Fig. 5). The range of hills are about 20 miles wide and have relief of about 350 feet. The eastward facing slope of the escarpment is generally made up of two or three closely spaced rock benches with the intervening slopes rising with steep gradients to the higher bench. The streams in the Flint Hills have deep precipitous channels lined with outcropping rock ledges. The valleys of the east or west flowing streams are characteristically asymmetrical with the steeper slopes on the south side of the valleys north of the Kansas river. The Flint Hills diminish in height and become less strong topographic feature than they are south of the river. Here the Flint Hills have been glaciated.

The surface of the Flint Hills is gently rolling and merges on the west with the smooth and gentle slope which slopes towards the Arkansas river valley. The hills mark the outcrop of a series of limestones that are banded with layers of flint or chert which is very resistant to weathering and erosion and tends to accumulate as rocky fragments scattered over the surface providing a cover for the weaker underlying strata (35-288).

The major part of the soils are described as immature and shallow soils on steep slopes. Major soil groups as Regosol-Lithosol and Rendzina developed as dark colored soils under prairie vegetation; the major soil group being Chernozem. The soils associated with the first major soil group are Sogn and Florence, they form a steep to undulating landscape with excessively drained Regosols or Lithosols integrating to Rendzina's on the steep slopes and well drained Reddish Prairie soils (Florence) or Chernozems elsewhere. They have very dark grayish brown, acid, stony, cherty clay loam surfaces and are underlain at shallow depths by weathered and unweathered consolidated shales and limestones. These soils yield excellent pasturage when properly managed (1-116).

The soils associated with the second major soil group are Crete-Hastings and Kipp. These are undulating to nearly level, moderately well drained to well drained soils. They have dark grayish brown, acid silty clay loam surfaces that are underlain by silty clay (Crete) or silty clay loam (Hastings) subsoil and bedrock (Kipp). They have developed calcareous loess shale and limestone residuum. These are productive soils, generally used for growing grain crops. Problems are erosion control on the sloping land and slow permeability on the nearly level areas (1-84).

The new soil classification system describes the soil groups as Udic Ustolls and soil series as Ustolls, Usterts and Udolls. They are made up of deep, moderately deep and shallow, dark grayish brown, and very dark grayish brown silt loams, silty clay loams, and silty clays.

The average annual rainfall ranges from 26 to 32 inches.

The potential natural vegetation is bluestem prairie, as dense stands of tall and medium tall graminoids with shorter grasses significant only in the western part. Forbs vary in height from low to very tall. They are numerous and can produce strong seasonal aspects. Dominant species are: big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), switchgrass (Panicum virgatum), Indian grass (Sorghastrum nutans). Other characteristic components are the same as for the western part of the Osage Cuestas where they blend together (22-595).

Fig. 37. FLINT HILLS - The surface of the Flint Hills is gently rolling. A 'Kansas Castle', a grain silo, draws attention in the wide landscape.

Fig. 38. FLINT HILLS - The eastward facing slope of the escarpment is generally made up of two or three closely spaced rock benches.

Fig. 39. FLINT HILLS - The hills mark the outcrop of a series of limestones that are banded with layers of flint or chert which is very resistant to weathering and erosion and tends to accumulate as rocky fragments scattered over the surface providing a cover for the weaker underlying strata. These exposed fragments provide beautiful horizontal lines in the Plains landscape.

Fig. 40. FLINT HILLS - Blue stem prairie in the fall with honey locusts growing in the draw making the best of surface run off water.

Fig. 41. FLINT HILLS - Aberdeen Angus cattle provide a bold color accent in the Flint Hills landscape. George Grant from Scotland imported the first Angus cattle in 1873 to his newly established agricultural community, Victoria, in Kansas. Today their descendants graze the Flint Hills.

G. Red Hills:

One of the more scenic parts of Kansas lies in the physiographic unit which is appropriately called the Red Hills (Fig. 5). The Red Hills define the highly dissected border of the Great Plains south of the tongue-like eastward projection of the High Plains. The underlying rocks of the unit are the red shales, siltstones,and sandstones, of Permian age. The name Red Hills is derived from the red color of the soil,and the rock exposed in that part of the state. Relief can be up to 300 feet even 500 feet (35-302).

Common topographic forms are small, table-like plateaux and flat topped hills. The bright red colors of the Permian shales, siltstones, and sandstones make for an extremely attractive scenery, of which the cause of course is erosion. The buttes formed because they are capped by the relatively resistant white gypsum beds. The Red Hills are drained primarily by the Amanon and Medicine Lodge rivers and their tributaries.

The major soil groups, immature and shallow on steep slopes, are Reddish Prairie soils. The soil associations are: Vernon-Quilan-Albion and Grant-Albion-Vernon respectively. The Vernon-Quilan-Albion is an association of soil series which occur on steep to undulating topography, and are excessively drained and have reddish brown or brown neutral, clay, fine sandy loam, and loam surfaces. They were developed from red, semi consolidated clay (Vernon), red semi consolidated sands (Quilan) and old outwash (Albion). Wheat and sorghum are grown on the undulating areas and beef cattle production is followed on the more sloping areas. Thin steep soils limit pasture yields. Erosion control and maintaining a grass vegetation through proper range stocking are problems (1-115).

The Grant-Albion-Vernon is an association of soil series which are slightly undulating to rolling, well drained to excessively drained soils with reddish brown, slightly acid, silt loam, loam or clay surfaces. The Grant soils were developed from red clay, and calcareous loess. The Albion from old outwash, and the Vernon from red clay. This is a wheat and livestock farming area. The nearly level to undulating areas are productive. Erosion control is a problem (1-78).

The new soil classification system describes the soils as belonging to the Ochrepts, Ustolls, Ustalfs and Psamments soil group and the soil associations made up of the soil series Vernon, Woodward and Quinlan in the east and Woodward and Carey series in the western part. These soils are described as moderately deep and shallow, reddish brown loams and clays, and deep, grayish-brown silt loams and clay loams and pale brown loamy fine sands and fine sands.

The average annual precipitation range is from 24-28 inches.

The potential natural vegetation is made of medium tall and short grasses and forbs which often form two distinct layers; the lower one is usually denser than the taller one. Junipers are scattered savanna-like over the prairie. Small groves of low broadleaf deciduous trees and shrubs occur in valley bottoms and on north-facing slopes. Dominant species are: big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), sideoats grama (Bouteloua gracilis), hairy grama (Bouteloua hirsuta), red cedar (Juniperus

Fig. 42. RED HILLS - The Red Hills define the highly dissected border of the High Plains. It is a scenic part of Kansas with its canyon landscape.

Fig. 43. RED HILLS - The name, Red Hills, is derived from the red color of the soil and exposed rock. The bright red colors of the shales, silt stones and sandstones make for an extremely attractive scenery.

Fig. 44. RED HILLS - On the surface the rectangular fields with Reddish Prairie Soils add another colorful dimension to the landscape.

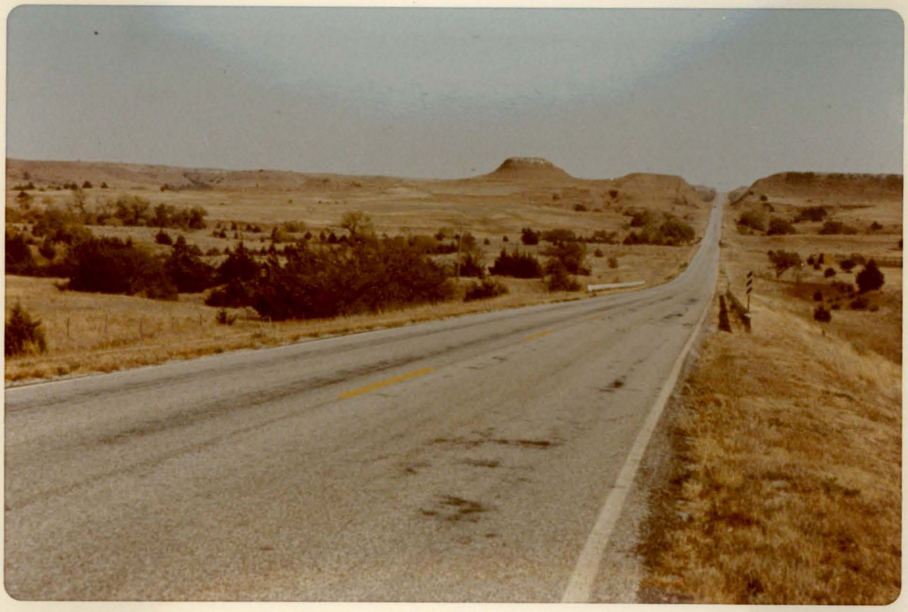


Fig. 45. RED HILLS - Common topography are small, table-like plateaus and flat topped hills. Buttes formed because they are capped by the relatively resistant white gypsum beds as seen along Rt. 160 near Medicine Lodge. These buttes help set this attractive landscape apart from the general gentle landscape as seen on the Plains.

Fig. 46. RED HILLS - Stream erosion exposing the red soil and rocks along a tributary of the Medicine Lodge river.

Fig. 47. RED HILLS - Red cedars grow abundantly along the canyon. They form a very characteristic part of the natural landscape with their rather deep green color during summer months. During winter the red cedar turns a reddish brown color which is the reason for its name.

virginiana) (22-594). Broadleaf deciduous groves consist of Celtis occidentalis, Populus deltoides, Prunus angustifolia, Quercus macrocarpa, Rhus glabra, Sapindus drummondii, Symphoricarpos orbiculatus, Ulmus americana.

Other characteristic components are Ambrosia psilostachya, Andropogon saccharoides, Aristida longiseta, Aristida purpurea, Aster ericoides, Buchloë dactyloides, Callirhoë involucrata, Carex gravida, Chrysopsis villosa, Echinacea angustifolia, Gutierrezia sarothrae, Liatris punctata, Nama stevensii, Oenothera serrulata, Panicum virgatum, Phacelia integrifolia, Prunus angustifolia, Psoralea tenuiflora, Solidago mollis, Sorghastrum nutans, Sporobolus asper, Sporobolus cryptandrus, Stenosiphon linifolius (22-595).

H. Arkansas River Lowlands:

The Arkansas River Lowlands consists of the valley bottom or inner valley of the Arkansas river and the outer valley of the Arkansas, including the terraces and land sloping toward the river but lying below the level of the High Plains (Fig. 5). On the north the valley plain is bordered by an almost continuous line of bluffs, some of which are 100 feet high and which are extensively cut by short stream valleys flowing into the Arkansas river. The greater part of the lowlands lies south of the Arkansas river; the topography is essentially flat. The river shows many sandbanks and runs shallow because water is diverted for irrigation (35-300).

The soil of this region belongs to the major soil group of Reddish Prairie soils. The Pratt-Albion Derby is the association of soil series with areas undulating to rolling and to excessively drained, except for small depressions which frequently are moderately well drained. The soils have brown to dark brown slightly acid, fine sandy loam or loam surfaces and sandy clay loam subsoils. They have developed from wind reworked old outwash. The principal crops are cash-grain, wheat and sorghum. The soils respond to good management which includes proper crop residue management to control wind erosion. Shelterbelts do well and help control wind erosion. Drainage of the closed depressions is needed in wet years or when irrigated (1-78).

Immediately along the river are the soils located which the major soil group describes as soils of stream bottom lands. These are unindifferated bottom lands. These areas consist of well drained to poorly drained soils on nearly level floodplains. Their surface colors range from very dark grayish brown to pale brown, and their reactions are acid to alkaline. Textures range from sandy loams to clay. They include alluvium in the Brunizem, Chernozem and Chestnut soil zones. The principal use is for general crops and livestock production. Parts of the area are too poorly drained for the production of cultivated crops. Management problems include streambank cutting, stream channel changes, flooding salinity and alkalinity.

The new soil classification system describes these soils as belonging to Udic Ustolls further divided in soil series Ustalfs, Ustolls and Aquolls. They are deep dark grayish-brown loams and fine sandy loams and pale brown loamy fine sands.

Fig. 48. ARKANSAS RIVER LOWLANDS - The Arkansas River Lowlands consists of the valley bottom of the Arkansas river. The quilted pattern of wheat fields and freshly plowed land is very typical for this rich agricultural landscape.

Fig. 49. ARKANSAS RIVER LOWLANDS - Rt. 281 near St. John. Shelterbelts do well in the Arkansas River Lowland and are needed to protect the light soil from blowing. These tall cottonwoods are used as an integral part of the shelterbelt. Their golden leaves provide a vivid beauty in the fall, especially when the sun sets, and the shelterbelts are viewed coming from the west while the dark evening clouds are forming in the east.

Fig. 50. ARKANSAS RIVER LOWLANDS - Large grain silos near the small community of St. John tell the importance of grain production in the Arkansas River Lowlands. The silos form strong vertical lines in a horizontal landscape. But because of the immensity of the landscape their boldness is an attractive element.

Fig. 51. ARKANSAS RIVER LOWLANDS - Bold form of a "Kansas castle" softened at ground level with small groups of trees and at its corners where the vertical lines meet the horizontal.

Fig. 52. ARKANSAS RIVER LOWLANDS - A hot summer day, wind still cottonwoods near a small pond along Rt. 156. An attractive group in the landscape and a frame for the silo at Claflin, the small town which road sign reads, "If you can't stop--smile as you drive by."

The average annual precipitation ranges from 22" along the western boundary to 28" along the eastern fringe.

The potential natural vegetation away from the river is medium dense stands of graminoids which are medium tall to tall. Forbs are common. The dominant species are big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), sandreed (Calamovilfa longifolia) and switchgrass (Panicum virgatum) (22-597). Other characteristic components are: Andropogon hallii, Artemisia caudata, Asclepias arenaria, Bouteloua curtipendula, Cenchrus longispinus, Eragrostis trichodes, Eriogonum annuum, Froelichia floridana, Gilia longiflora, Helianthus petiolaris, Heterotheca subaxillaris, Lespedeza capitata, Oenothera rhombipetala, Paspelum setaceum, Petalostemum villosum, Prunus angustifolia, Scirpus acutus, Scirpus validus, Sporobolus cryptandrus, Typha latifolia (22-599).

Scattered along the river are tall, medium tall, and low broad-leaf deciduous trees and shrubs. The prairie is suppressed wherever the woody plants form dense groves. The dominant species are the cottonwood (Populus sargentii) and peachleaved willow (Salix amygdaloides) (22-600).

I. Smoky Hills:

The Smoky Hills are made up of a strip of land, north of the Arkansas River Lowlands (Fig. 5). The Smoky Hills are a naturally dissected broad hilly belt. Early settlers probably named them so because of an atmospheric condition that partially obscured the low hills as they are viewed across the plains from east and south. There are actually three levels of hills in this region with the crest of each range occurring at progressively higher elevations from east to west. The eastern part is carved essentially in the Dakota sandstone and in places has a relief from 200 to 300 feet. West of the range underlain by Dakota sandstone lies the area which is often referred to as "Land of the Post Rock." The hills here consist mainly of inter-stratified limestones and shales. This area has a more regular type of topography than the less uniformly bedded Dakota sandstone. The Greenhorn Limestone found in this area is made up of numerous thin beds of chalky limestone, generally less than a foot thick. They are alternated with thin layers of shale. This foot thick limestone was quarried throughout the region for fence posts and building stone as few trees were to be found here to build homes from or construct fences with.

The rivers which occupy the valleys are flat bottomed and range in width from less than one, to several miles. The north facing river bluffs are generally steep and short, while the south facing valley walls are much gentler and longer (35-311).

Along the eastern boundary the soils belong to the major soil group of immature and shallow soils on steep slopes. The Regosol, Lithosol, Rendzina series is made up of Hedville-Lancaster series, which are undulating to hilly, well drained to excessively drained soils with dark grayish brown, acid, loam or silt-loam surfaces, and sandy loam or loam subsoils which have developed from sandstones. These soils are used primarily for general crop and livestock farming. Although inherently moderately low in fertility they respond well to good management which includes fertilizer applications. Problems are erosion control, acidity, shallowness of soils and droughtiness (1-117).

West of these soils are the dark colored soils developed under prairie vegetation. The major soil group is Chernozem, the soil associations are formed by the series Crete-Hastings-Nuckolls. These are nearly level to rolling, moderately well drained to well drained. The soils have dark grayish brown to dark brown, acid, silty clay loam surfaces and silty clay and silty clay loam subsoils. They were developed from calcareous loess. Wheat sorghum and alfalfa are grown in the north and wheat and sorghum in the south. The soils are productive. Erosion control is a problem in the more rolling areas (1-85).

The new classification system describes the soils as belonging to the Typic Ustolls soil group. They are Ustolls and Usterts series which are deep and moderately deep, dark grayish-brown silt loams and moderately deep gray clays.

The average annual rainfall ranges from 20 inches in the west to 28 inches along the east.

The potential natural vegetation consists of graminoids and forbs which often form two distinct layers, one of low growing grasses and one of medium tall growing grasses and forbs. The upper layer is usually more open. Dominant species are: big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), sideoats grama (Bouteloua curtipendula), blue grama (Bouteloua gracilis). Other characteristic components are: Agropyron smithii, Ambrosia psilostachya, Amorpha canescens, Aristida purpurea, Asclepias tuberosa, Bouteloua

Fig. 53. SMOKY HILLS - The Smoky Hills are a naturally dissected hilly belt in the east, underlain by Dakota sandstone. Atmospheric conditions, partially obscure the low hills when viewed across the Plains from east and south and gave the region its name.

Fig. 54. SMOKY HILLS - Land of the post rock.

Fig. 55. SMOKY HILLS - More regular topography along the western part of the Smoky Hills. Here the land is underlain by inter stratified limestones and shales. The setting sun shows the warm colors of the limestone fence posts, small vertical dots along a horizontal line.

Fig. 56. SMOKY HILLS - From a sod house to a stone house to ----?
Old stone farm home in the Smoky Hills.

hirsuta, Buchloë dactyloides, Clematis fromontii, Dalea enneandra, Echinacea angustifolia, Elymus canadensis, Erysimum asperum, Hedeoma hispida, Koeleria cristata, Liatris punctata, Lithospernum incisum, Oenothera serrulata, Panicum scribnerianum, Panicum virgatum, Paronychia jamesii, Psoralea tenuiflora, Scutellaria resinosa, Sorghastrum nutans, Sporobolus asper, Stenosiphonon linifolius. These are usually found on the uplands but they also extend westward in the valleys of the dissected parts of the High Plains where the uplands are occupied by the grama-buffalograss prairie. Along the streams in the valleys are found the cottonwoods (Populus sargentii) and the peachleaved willow (Salix amygdaloides) (22-591).

J. The High Plains:

The High Plains are in general a treeless, and on a regional basis, a featureless plain. The region covers approximately 30,000 square miles or about 36% of the land area in the western one-third of Kansas (Fig. 5). The High Plains' surface rises gradually westward at an average rate of 10 to 15 feet per mile. The High Plains constitute a partly dissected plateau which is characterized by broad flat uplands which in places are undrained. The surface is not without relief, maybe as much as 300 feet. The major river valleys are broad and have gentle slopes which extend downwards to relatively narrow flats. Minor valleys in many places are steep sided narrow canyons. There are also areas which are hilly and covered by sanddunes (35-113).

Geologically the High Plains are for the most part underlain by Tertiary and Quartenary deposits, most of which are unconsolidated or poorly cemented. The nearly flat alluvial plain developed in late tertiary time. During Pleistocene it was very much dissected. Much of the coarse sand and gravel was carried to the High Plains by streams that flowed from the mountains west, while other sandy deposits in this area came from streams that flowed from the fronts of the Pleistocene glaciers. As the glaciers gradually melted and retreated northward, large expanses of drying mud were exposed and dust storms deposited thick blankets of windblown silt or loess across much of Kansas (46-327).

The soils belong to the Major Soil Group of soils developed under prairie vegetation and are dark colored soils. The soil series are Chernozem and Chestnut and Brown. The Chernozem soil association is Hasting-Holdredge. These soils are undulating to nearly level and they are well drained. They have dark grayish brown, slightly acid silt loam surfaces and friable silty clay loam subsoils. They were developed from calcareous loess. Steeper areas with thinner and lighter soils are present along streams. Agriculture consists of general crop production on the level areas and grazing on the steeper slopes. The soils are productive but erosion control is a management problem, in particular on the slopes (1-82).

The Chestnut and Brown soils associations are Keith-Colby and Richfield-Colby. The Keith-Colby soils occupy a nearly level to gently sloping plain, dissected by numerous narrow, steep-sided drainage ways. They are well drained soils with very dark grayish brown, neutral silt loam surfaces and friable subsoils. They have developed from calcareous loess. Cash grain farming is the principal enterprise. The high natural fertility is easily maintained by good management. The chief problem is to control water and wind erosion under the wheat and summer fallow cropping system (1-87).

The Richfield-Colby soils are nearly level to slightly undulating, and are well drained. The soils are dark grayish brown to light grayish brown and neutral. They have silt loam surface soils and fine silty clay loam subsoils. These soils are found on the nearly level flats and have developed from calcareous loess. Wheat and sorghum are the principal crops. These soils are productive; the chief problem is wind erosion control (1-88).

The new soil classification system describes the soils along the east of the High Plains as belonging to the Typic Ustolls major soil group. The soil series are Ustolls and Usterts, they are deep and moderately deep dark grayish brown silt loams and moderately deep gray clays.

The western half belongs to the major soil group of Aridic Ustolls. The soil series are Ustolls, Orthents and Ustalfs. They are deep grayish brown and dark grayish brown silt loams.

The average annual precipitation ranges from 15 inches in the west to 22 inches along the east of the High Plains.

The potential natural vegetation along the eastern section of this region is as for the Smoky Hill region with the High Plains vegetation extending eastward along the higher ground. The vegetation cover is made up of fairly dense stands of short graminoids with somewhat taller grasses in the eastern sections, forbs are common. The dominant species are blue grama (Bouteloua gracilis) and buffalo grass

(Buchloe dactyloides). Other characteristic components are Agropyron smithii, Aristida longiseta, Aristida purpurea, Artemisia frigida, Astragalus seriocoleucus, Bouteloua curtipendula, Gaura coccinea, Grindelia squarrosa, Haplopappus spinulosus, Lygodesmia juncea, Opuntia imbricata, Paronychia depressa, Phlox andicola, Plantago purshii, Psoralea tenuiflora, Ratibida columnifera, Sitanion hystrix, Sphaeralcea coccinea, Sporobolus cryptandrus, Stipa comata, Yucca glauca (22-590).

South of and along the Arkansas river the vegetation is made up of medium dense stands of tall graminoids with low shrubs and forbs. The dominant species are sand bluestem (Andropogon hallii), little bluestem (Andropogon scoparius), sandhill sage (Artemisia filifolia), sandreed (Calamovilfa longifolia). Other characteristic components are: Artemisia caudata, Asclepias arenaria, Bouteloua curtipendula, Carex heliophila, Eragrostis trichodes, Erigeron bellidiastrum, Gilia longiflora, Oryzopsis hymenoides, Panicum virgatum, Petalostemum villosum, Prunus angustifolia, Sporobolus cryptandrus, Stipa comata (22-597).

Along the floodplain of the Arkansas river and other small streams grows the cottonwood (Populus sargentii) and the peachleaved willow (Salix amygdaloides) (22-601).

In applying the principles of landscape design outlined in the dissertation [i.e. that one must know the theory of landscape (Chapter I), the evolution of the natural and cultural landscapes of the whole region of which the area to be designed is a part (Chapters II, III) and the basic principles of landscape design (Chapter IV)], the

Fig. 57. HIGH PLAINS - The High Plains are in general a treeless and on a regional basis a featureless plain. Two horses provide a sense of scale in this wide open landscape.

Fig. 58. HIGH PLAINS - The railways helped open up the land and towns sprang up along the straight tracks.

Fig. 59. HIGH PLAINS - On the High Plains the straight lines run to the horizon. Farm machinery with its bright colors is part of the landscape and helps to provide scale and interest in the treeless expanse.

Fig. 60. HIGH PLAINS - Irrigation on the High Plains. An agricultural landscape of stark, simple beauty.

Fig. 61. HIGH PLAINS - A temporary point of interest in the landscape, a small mass in a large void.

Fig. 62. HIGH PLAINS - A more permanent point of interest on the High Plains. A still functional old barn and water mill. A cottonwood planted on the shaded north side corner of the barn would have added another dimension and it would have softened the lines of the old barn.

Fig. 63. HIGH PLAINS - Yucca, native plant material of the High Plains!

designer must be aware of the character of the particular area; this character is determined by its land forms, vegetation, soils and climate, as well as by its cultural landscape forms. For instance, in Kansas, as mentioned earlier, there are 10 physiographic regions described in this chapter, each with a different natural landscape character and each area is subject to the factors stated in the beginning of this chapter. The landscaper should be aware of the landscape character of all areas of Kansas before he can work with any particular one because often there is an amount of overlapping of characteristics within the areas adjoining each other.

An Inquiry into the Values and Feasibility of a National Landscape Park in Kansas

One solution to the problem of relating the plantings and planning for the immediate future, to long term planning for a whole region, is the possibility of National Landscape Parks. A congress at the University of Utrecht in the Netherlands, sponsored by the Society of Biologists of the University of Utrecht, first mooted this idea but similar proposals and ideas are circulating in England. Although in both countries this concept is being studied in the hope of establishing experimental parks, nowhere is there as yet an established National Landscape Park in operation. In order to advance the study of this concept in this country we should first define the potential site criteria of a National Landscape Park.

A National Landscape Park should be an area of at least 25,000 acres, consisting of both natural terrain, waterways or forests, and cultivated areas and settlements; both should possess the potential for natural and landscape beauty, together with important qualities from a cultural-historical point of view, all forming a coherent harmonious unity.

The work of the designer of such a Park is first to translate the ideas and philosophies of land use which are the basis of that definition (and the substance of the preceding chapters) into practical guidelines. To do that we have to clarify our definition further under the following headings:

I. The meaning of a National Landscape Park.

II. The criteria for its selection.

III. The effect on the farmer or rancher within the park.

IV. Its management and control.

V. Areas in Kansas which might qualify for being a National Landscape Park.

I. In establishing National Landscape Parks, protection of natural areas and conservation of the landscape could be integrated with larger considerations and thus become a much stronger preserving force than what is usually understood by nature protection alone. For the protection of the total landscape starts out from the principle that in order to preserve the esthetical values we need to protect both the natural areas and the cultural-historical values.

Regional landscapes have evolved by the particular and peculiar interaction of man and nature characteristic in that region, and in the proposed landscape parks those characteristic elements of that interplay must be identified by the designer; the value he sees in the landscape can be better perceived by its inhabitants when we set the area aside and explain its significance. People can be educated to become more conscious of the relatedness of man and nature and thereby more aware of the landscape around them. Education, as was said earlier, is part of the professional life of the designer.

In the protection of nature and landscape, important social interests are at stake: the functioning of the individual in his surroundings and in society as such--i.e. his spiritual and physical well-being and with the basic philosophies of his society. This is what is meant by a functional regional landscape. The very act of planning National Landscape Parks is an expression of the values our society can attach to a landscape in which older cultural forms are not destroyed but revered and appreciated as an historical perspective for our culture. Though the settling of the midwest is so recent in history, we should not lose the only means of identifying ourselves with it. A Landscape Park could serve as a center and focus for educating people to this awareness of an historical past which functions in the present and conserves for the future (see Chapter I).

It may be through my personal experience, having lived in different parts of the world, that I sense so acutely the need to be able to relate to my surroundings. But I believe that basically this holds true for all people, and that not many actually can explain the psychic restlessness which we experience when this relationship is broken.

The significance of a National Landscape Park which is a functioning regional landscape is therefore primarily educational but may also be therapeutic.

II. When we consider how to select areas as Landscape Parks, we know by definition what we are looking for. To develop a system for classifying potential Park areas it would be possible to map a region according to the following criteria:

A. Natural beauty, specific scenic spots, unusual geomorphological structures and important biological ecosystems, as defined in Chapters II and IV.

B. Cultural-historical: historical-geographical elements such as remnants of old settlements, monuments of historical architecture like farmsteads, churches, barns, fortifications, and archeological monuments, etc., as defined in Chapters III and IV.

The data could be worked into two different maps and by placing one on top of the other, much like the Ian McHarg method, we could determine which area would have most of the dual qualities we are looking for.

We also need to consider the planological and social-economical criteria, especially those concerning the fourth dimension of time, so important for plant material: are there developments to be expected which cannot be brought into accord with the objectives we envision for the Landscape Park? This brings us logically to our third point.

III. It is clear that in the selection of areas for Landscape Parks the emphasis will vary as to which is of primary importance: nature or agriculture, or the combination of the two. We will have to strive for an integrating of all interests. The position of the farmer is indeed a very difficult one. On the one hand there must be a "living" agriculture within the park, for without it we would lose the dynamics of the landscape and it would take on a "museum" character. We must at all times prevent rigidity. On the other hand, while we realize that it has been to a large extent the farmer who, through the ages shaped the land to what we now call the cultural landscape, yet with the development of modern farm methods, the mechanization, he fits less easily in the natural landscape; with the heavy fertilizing and use of pesticides the farmer may in reality damage existing ecosystems. Yet he is forced to continue these practices since his economic security and independence are at stake. Farming is no longer a way of life, it is a business like all others. For the farmer, his land is not just the place where he lives, but also his means of production, unlike the town and city dweller.

In parks where the primary emphasis is on ecological values, the farmer may have to accept some restrictions in respect to his farming methods and possibly some areas may have to be withdrawn from the agricultural industry.

If a willingness to accept such changes exists, then the search for cooperation between park use and agricultural use offers perspective. Such cooperation requires knowledge of each other's position and the mutual acceptance of the essential consequences of it. There are costs involved, not only financial ones, and who will pay the price? How can we best convince people the investment is worthwhile? This is obviously another criterion in selecting Park sites--the willingness of those in the area to become participating and essential units in a functional landscape.

IV. Management and control of the parks is closely related to the problem of financing. It seems to me that, though the areas designated as National Landscape Parks must be significant for all Americans (hence the use of the term "National") the jurisdiction must be under the State Government, and financed by the State. There should be a special legal advisor for each park to cope with private property holders' interests.

There will have to be a legal ruling which incorporates this, and the foundation must be laid for a clear right of landowners and tenants to fair market compensation for loss and recompense for services rendered to the park. This must be spelled out before introduction of these ideas to the people can take place. Without it, no concrete proposals can be made. This, then, is the final criterion of practicably selecting Park sites; if adopted it answers the problem raised in the third section above, and leaves the way clear for the proper business of the designer--the selection of sites which exhibit the significance which is the principal criterion for selection. That significance is obvious: America's wealth is based on the historic role of agriculture when most of her people were farmers; the Park exhibits the past to all Americans. But it also demonstrates the future, since it is becoming clearer that America's world power is likely to reside not only in industry but in agriculture, in her power to feed the people of the world with bread as she has fed them with ideas since 1776. A functioning regional landscape park would relate past and future in the living, dynamic present.

The question now is, can Kansas show the rest of the Union how to do this? The next section takes the first step by identifying two potential sites.

V. A. Michael Frome, one of the nation's leading travel writers and an authority on the ever changing face of the American landscape, was asked to pick the fifteen places that are most important for a traveler to visit if he would really know America. Frome chose the Flint Hills of Kansas as one of the fifteen places.

The Flint Hills are so named, because of the deposits of blue-grey chert, or flint, found in certain varieties of local limestone. They are characterized by rough limestone outcroppings, lush bluestem pastures, rugged farmsteads, built out of limestone and oak, beautiful vistas, and secluded wooded valleys. It is an area of ever changing colors and textures, a scenic region often overlooked in our haste to arrive at a destination beyond it.

At the time the vast prairie spread westward from the eastern forest it was a sea of grass, sprinkled with wild flowers. The native prairie has to a large extent been replaced by fields of corn and wheat, but in the eastern part of the Flint Hills in Kansas one can still get an impression of what this vast landscape must have been like with its rolling hills, flats and broad vistas. Here the few developed farms and fields are in the level lowlands. The rest of the region is typical of the original prairie dominated by the tall bluestem.

The characteristic grasslands of the Flint Hills evolved through a combination of factors. Moderate rainfall provided adequate moisture to support a wide range of plants; during years of drought, prairie fires caused by lightning succeeded in killing off the small woody plants, but did little harm to the grasses. Grazing by the native bison and elk also helped in keeping the woody plants from becoming established during normal years. The strength and the permanence of the prairie grasses, their ability to endure this long history of ecological forces is one of the beauties of the Flint Hills, but it is available only to the eye of the educated observer.

Through the region one finds outcroppings of limestone. Above the limestone a thin, fertile soil supports a variety of plants. Little bluestem, needlegrass, and prairie dropseed are the most abundant, but side oats, grama and switchgrass can also be found. Tall bluestem and Indian grass exist in the lowlands while some of the poorer soils of the uplands can only support grasses of western plains. Forbs such as lead plant, the sunflowers, prairie cone flower, windflower, verbena, wild indigo, gayfeather, and fleabane all add color to the hills.

Deep valleys are worn into the limestone layers. These valleys with their steep, rocky walls and numerous small springs support the majority of the woody plants of the region. Here small and larger trees found protection from the prairie fires. Among the varieties present are: eastern red cedar, sycamore, chinkapin oak, basswood, black walnut, hickory, hackberry, and burr oak. Small flowering trees are black locust and redbud.

Where the valleys become wide, the fertile soil supports many

"NATIONAL LANDSCAPE PARK - FLINT HILLS"

Fig. 64. During spring, summer and fall wild flowers add to the scenic beauty of the rolling Flint Hills.

Fig. 65. A corner full of "weeds" near the holding yard.

Fig. 66. In the fall bluestem grass on the Flint Hills is curing to a tawny brown in the autumn sun.

Fig. 67. Shadows of summer clouds gently touch the hills.

Fig. 68. The Kansas river flowing through the Flint Hills near Manhattan.

Fig. 69. Tuttle Creek reservoir, a man-made lake in the Flint Hills, creating a different landscape,---

Fig. 70. ---and providing water recreation.

Fig. 71. An old watermill near an abandoned homestead--part of the cultural landscape even today.

Fig. 72. The Kansas state flower--the Sunflower.

Fig. 73. Rt. 177 near Cottonwood Falls, 'an empty curve', a treeless road.

Fig. 74. Rt. 177 with one cottonwood near the road close to water. The tree alerts the driver, it stimulates, it provides interest, it helps crossing the bridge safely. The tree is part of a functional regional landscape.

farms and the wide flat flood plains of the numerous rivers which cross the region are farmed extensively.

A closer look at the old homes of the region with their solid limestone walls and hand-hewn oak beams shows a true sense of beauty and a close feeling for the land.

B. Just as the Flint Hills have their own regional character so do the Smoky Hills. The uniqueness of the Smoky Hills is not so much expressed in its topography and plant material as in the extensive use of native stone for fence posts as well as buildings. The first was the most important and gave this region its uniqueness and its name: "land of the postrock" or, "fencepost limestone country." The limestone fenceposts are a regional trademark and a unique aspect of the landscape in north central Kansas.

The use of fences to enclose territory is an age old practice. Lack of suitable wood for fencing crops from cattle on the open range forced pioneers to look to other materials. The pliable limestone found in the region was a cheap and highly durable material. Limestone posts, each with their own personality of form and color, have supported barbed wire fences around thousands of prairie acres in north central Kansas since the 1870's.

The native stone was primarily used for farm fence posts. All sizes and shapes were used, but the average is about 9 inches on each of the four sides with a length of 5 to 6 feet, each weighing 250 to 450 pounds. The posts were set in the ground about 18 inches. During the construction period of many of the fences around 1880 to 1890 such posts were delivered to the fence line for 25 cents each! Depending on the weight of the posts, four to eight of them made a big load for a team of horses.

The postrock region is marked by the use of stone posts from the western border of Washington County, southwest for almost two hundred miles into northern Ford County. The area is from ten to forty miles wide. It is estimated that about forty thousand miles of postrock fence can be traced throughout this area.

The stone, a chalky limestone appropriately called Fencepost Limestone, is present near the prairie surface in uniformly thick layers of about eight or nine inches. The rock is soft enough to be easily notched or quarried, but the rock hardens into relatively weather resistant rock after prolonged exposure to air.

Besides fenceposts many of the early schoolhouses and most churches were constructed with the fencepost limestone.

By 1920 the quarry cost of limestone fenceposts had risen from 25 cents to one dollar, wooden and steel posts could be more easily obtained, and that economic factor marked the end of an era which gave the Smoky Hills a cultural landscape character which even today is still its own.

These two-toned, light tan rusty brown stone posts are our heritage of north central Kansas. Such landscapes should be preserved, not so much in a museum, but more as an unique feature of a functional regional landscape--functional because those posts still work.

The preservation and conservation of such a landscape must at this stage be done, mainly by the land owners themselves, which is

"NATIONAL LANDSCAPE PARK - LAND OF THE POST ROCK"

Fig. 75. "Land of the Post Rock," 250 pound post for 25 cents, still standing today fulfilling its function.

Fig. 76. Rock posts come in all shapes, some have a fancy top.

Fig. 77. Others have the typical brown streak caused by iron stain.

Fig. 78. Some farmers built 'spite fences' when they were not sure of the exact boundary location, or to keep livestock away from each other.

Fig. 79. An old farm home near the eastern part of the Smoky Hills. Sandstone and limestone were used in the construction, creating a unique stone effect.

Fig. 80. A limestone farm building partly hidden by trees, a reminder of the recent past.

Fig. 81. Stone taken from under the sod close by gives this home its character. Notice the rough surface and large corner stones used. Such homes, barns, as well as the stone fence posts and stone bridges, create the strong regional landscape character of the Smoky Hills "Land of the Post Rock."

Fig. 82. The large walnut tree gives a scale to the home, helped enframe it and provided shade as well as nuts for man and nesting places for birds.

Fig. 83. The roof line still straight, the whole structure even in its dilapidated form, still shows strength. The architectural line was rigid. Native building stone was worked down to a smooth finish. These homes are monuments to a recent past and are bold elements in the wide landscape.

Fig. 84. Courthouse at Lincoln, Kansas reminding us of the past while standing in the present and looking to the future. A very attractive structure built of native limestone. Most of the elm trees which were so commonly used along the streets and in the parks of our western towns are dead or dying because of Dutch elm disease. New tree planting programs help overcome the loss of these trees. Each generation has the challenge to plant for the next and especially when done near public buildings such as county seat, we express hope for the future.

not an easy task. But the idea has already been suggested.

Grace Muilenburg in her book Land of the Post Rock gives a vivid description of Post Rock region, writes as the very last paragraph:

> To preserve the Post Rock landscape is an obligation the people of the area have to themselves, to the State and to all visitors who came to admire it. (27-168)

I believe that indeed the Post Rock region should be conserved but to expect the local people to be willing and concerned enough to make the financial sacrifice is expecting too much, given the attitude to landscape today. That is the reason why I would recommend to have this region set aside as a National Landscape Park--it would test all four preceding points.

Conclusion

We cannot say that this is only a vision with no history of a culture on which to build an appreciation of the landscape. Although our Great Plains history may be brief, a culture typical of Kansas has developed, of which the best must be used as a further stimulant.

The landscape of the Plains has come a long way from the day it was settled. L. R. Elliot vividly describes such a scene when he observed the very last great American landrush, September 18, 1893. It was the settlement of a strip of Indian land, 59 by 150 miles in size just south of Kansas west of the Arkansas River.

> Every five miles the train slowed up or stopped, and many took to the prairie for claims. It was not even necessary for the train to stop. Strippers would pitch out the bundle and roll after it in the sand, hastily rush for the wire fence and for the land on the other side of it. . . . (32-316)

It would be tempting to imagine a similar rush today--not to stake a claim but to enter the Flint Hills or the Smoky Hills National Landscape Park. Lest that be thought too visionary and impossible an idea, one should remember the difficulty many of the sponsors of other National Parks had in seeing their vision translated into reality--and then try to fight your way through the traffic jams into one of the popular National Parks at mid-summer. The vision of a National Landscape Park may be before its time, but its time is not too far distant.

The conclusion to this section of this chapter also serves to make the point of the dissertation. The space devoted to the idea of the National Landscape Park and to the suggestion of two possible sites is undoubtedly scanty, and the dissertation could have been written entirely on a detailed blueprint for one of the sites to convert it into such a Park. But that is to mistake the argument of the dissertation: it is only possible to reasonably quickly identify potential sites (and then work out the blueprint) if one possesses the detailed and extensive background in esthetics, geology, soil science, climatology, plant material, and social and cultural history outlined in the preceding chapters. To demonstrate the principles not just for one small area of one state in the Great Plains region, but for the whole region. All the preceding chapters play a part in this one and especially in its final conclusions which is, in effect, a demonstration of the practical value of the theoretical material preceding it.

CHAPTER VI

CONCLUSIONS: A METHODOLOGY FOR USING PLANT MATERIAL TO CREATE A FUNCTIONAL LANDSCAPE

To produce good general landscape, mass production methods are essential. This does not mean mass produced designs imposed regardless of local conditions but a standard method of treatment which, when applied to the local situation, will produce an appropriate landscape. We therefore need a system of landscape practices to specify methods of design and especially maintenance. To set up such a system, we can identify four land use categories. They are the town, the fringe of a town, the rural, and the natural areas.

These four categories are not those of landscape quality, but of type. Each area can be assessed and then plotted on a map as one of four categories of environment. If each were clearly defined and developed, we should have four distinctive types of environment where land use would be combined in suitable landscapes. Mapping the four different categories of environment would thus be a first step in plotting landscape regions, after they have been identified by the criteria of the preceding chapter. With the four categories plotted, the appropriate scenery could then be established scientifically and professionally. New development could be sited in the landscape where it belongs to produce a homogenous environment.

The system should satisfy three conditions. First, the directions should be set out clearly for everyone to follow. Secondly, the method should be simple enough for casual and untrained labor to carry it out. Third, it should be based on ecological principles so that it works with natural processes instead of against them (42-345).

To judge landscape by type and not by scenic value prevents the neglect of the nonscenic through putting all efforts in the preservation or conservation of that which is scenically attractive. It is the nonscenic areas which need often most attention. We need to extend the concern for amenity so that it covers the whole of our scenery and so that better landscapes are created for every kind of land use in terms of its district identity.

Man's effect on a rural landscape is almost entirely through the use of vegetation, apart from construction such as reservoirs and spoil heaps from strip mining. Today's modern farming creates an open landscape, a landscape composed of few masses and much space. As farming methods today increasingly supply the spaces, landscape design must supply the masses.

Landscape design is a three dimensional arrangement of masses and voids or spaces. In landscape, the masses consist of land forms and of vegetation, especially trees and shrubs. Space may start at ground level with water surface or grass. The shorter the grass, the more distinct the design of space. The ground spaces can be defined by land form shrubs or trees.

In a natural setting where native trees, shrubs, and grasses grow we can observe that the arrangement of vegetation is generally different from our cultural tree, shrub, and grass arrangement. Woodlands develop through the invasion of the herb layer by a competing growth of shrubs and trees which gradually suppress all vegetation which is not suited to the final community in the climax. Where exposed to light, however, the edge of natural woodland is often a solid bank of green during the summer. All the layers are present from tree tops of tall trees to smaller trees, to shrubs, to grass at ground level.

But it is not only the arrangement which is generally different between the establishment of natural and cultural plantings; there also is the natural selection through the survival of the fittest, which is a rigorous natural law. In a natural woodland setting of twenty square yards, more than a hundred seedlings may compete in the beginning to fill a vacant spot and through elimination and progressive crowding out of the weak in the end only a single tree is left. During its growth this tree had the competition but also the support of the other trees to force it along. In cultural landscaping often one tree is planted on such a space with no question of choice by competition nor survival of the fittest. We should keep in mind that trees are woodland plants and benefit from growing up together. Although only one tree is needed to fill such a space, a more natural approach to tree planting would be to plant more of smaller sizes which do not need staking and allowing them to grow up together, controlling them by selective thinning.

In practice then we must modify nature's methods; but these two facts of natural growth, that vegetation grows in layers and that plants compete, we can use to our advantage in landscape management. Design and maintenance cannot be considered apart. Planting and the control of subsequent growth must be planned for in terms of each other. If this is not done, any landscape design is likely not to survive. Maintenance is mainly the management of vegetation and by accepting natural layered growth, we eliminate much unnecessary maintenance mowing.

Grass is the vegetation layer which creates most maintenance problems. As a basis for space and design, the management of grass, can, as a farm crop be either harvested or grazed, or it can be used as a ground cover maintained by frequent mowing. This is generally the case in town. In urban situations, grass is an important part of the design. Mowed closely, it clearly establishes open space. Grass is a vegetation we can walk on and its functional use is often in recreation areas to play on. Last, in natural areas the function of grass is being the lowest layer of the vegetation. It is not used to walk on, but yet it is often mown to hold back the natural succession to shrubs and trees. Along our roads, especially near intersections, are many examples of such unnecessary maintenance.

The suppression of shrubs through mowing is regrettable, as the shrub layer could be used far more in the landscape where open ground space is not needed. Thickets of shrubs left to grow would provide interesting visual variation in many places where they belong.

Because most of our planting is in the open, we are mostly planting in wood edge conditions when planting on a regional scale, which produces more suitable landscapes for country areas. Here we need a non-garden style of landscape design for non-garden land.

Systematic regional landscaping therefore needs specific planting methods both for planting and for controlling growth in the four different categories of landscape mentioned earlier.

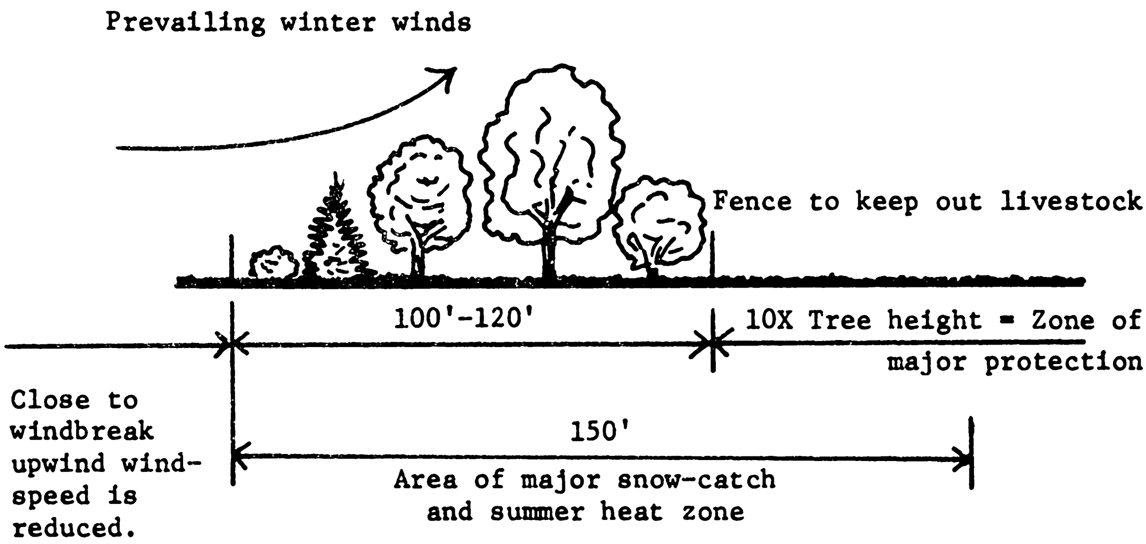
We recognized that where conditions favor tree growth, natural plant growth generally occurs in layers. Plants intermingle with short grasses, tall herbs growing through low shrubs and shrubs merging with trees having no open spaces between them. This is natural, especially along the edge of a wood lot. From this man has taken three variations for his landscape design in towns: he has separated the vegetation into trees, shrubs, and grass, creating an unnatural effect, needing greater maintenance; he has changed the order of the layers by growing trees away from shrubs with grass between them; and he has omitted a layer when growing trees in grass. Whatever the actual plants, these common modifications of natural growth form produce a garden effect. By planting more naturally, we can produce more suitable landscapes for country areas. By choosing local vegetation and planting close, we follow the natural law of the survival of the fittest on both large and small scales. By planting more naturally, we will produce more suitable landscapes for country areas, and the plants will grow faster and need less maintenance.

We have just identified four distinct types of plant design and earlier we established four landscape categories. They were the town, the fringe of the town, the rural and the natural landscape. How should these eight elements apply to each other or which combination can only be used?

In the town or urban landscape, a more formal plant design is generally used although it does not always have to be so. But generally, the three distinct plant layers are kept separate in different variations of design, resulting in a more formal arrangement which in town is the acceptable thing. The maintenance cost for town plantings if generally high. Lawns are mowed and neatly trimmed. Trees and shrubs must be selected and planted with care. Trained people prune and cultivate the plants. Town landscape demands specialized knowledge of plant growth in very often highly unnatural conditions. The spaces inhabited are small, such as streets, gardens, squares, and the spaces between buildings and parks. All of these are self contained landscapes with exceptions where there is an opportunity to blend units together, as, for instance, a tree lined street running into a park. Town landscapes are separate and have little effect on the general regional landscape. In these landscapes it is very possible and generally accepted to use introduced, non-native, plant material.

In contrast to the town's landscapes stand the rural landscape. On agricultural land, the process of farming provides both design and maintenance. In the rural landscape, the country, all urban effects should be avoided. Only close to the homesteads are the formal landscape designs appropriate, as around homes in town. Along the edge of the home and buildings complex, a more natural design should be developed. Our use of the natural design should suit changes in farming and, of course, maintenance. The basic material of the Kansas countryside is grazing and crop land; and since it is essential that agriculture should be efficient, the farmed landscape cannot be interfered with too much. Any modification of farmland for the sake of amenity can only be minor. Although the character of farm landscape may vary depending on the type of farm (livestock, or crop farm, or both) this will not change landscape design. This will be along the principles of natural vegetation with as many layers of vegetation present and planted naturally with close plantings, resulting in landscape planned in terms of its uncompromisingly functional scenery.

The older agricultural landscape of smoothly cultivated farm fields covered with crops in monoculture, or grass land surrounded by windbreaks is an attractive country scene regretfully passing with the removal of many of the shelterbelts. Today's new countryside is simpler than the former and was started on a grand scale in the early thirties. The bare expansive farmed areas will create the character of the new rural landscape. Because of the trend to such vaster, more spacious rural landscape, more emphasis should be put on planting extensive windbreaks around homesteads to provide some mass to offset the space. Also, where windbreaks are maintained on the southwest side of fields and space is available, the straight line effect should be broken with less rigid planting in the corners of the fields. With today's large circular irrigation systems covering 160 acres from the center, such corners are available. Also, along many of the roads through the fields where topography provides moisture advantages, clumps of vegetation using natural design should be planted. Trees can be under-planted with shrubs and forbs and grasses allowed to grow. Along the road, mowing should be carried out only for a narrow strip. The aim should be to conserve and encourage the growth of wild flowers. The nonagricultural land of large natural gas distributing complexes, buildings, complexes, and roadside rest stops are areas



A good tree windbreak reduces wind velocities 5 to 10 tree heights upwind, and 10 to 30 tree heights downwind. For extreme wind and snow conditions plant tall and short trees, evergreens and shrubs. Plant rows 15 to 20' apart to permit cultivating for week control. Because of winter snow drifts, keep buildings and roads some distance away.

Fig. 85. Wind modification resulting from a windbreak.

Row 1
Multiflora rose
Lilac
Honeysuckle
Tamarix
Chokecherry
Nanking cherry
American plum
Sandcherry

Row 2
Redcedar
Austrian pine
Ponderosa pine
Scotch pine
Rocky mountain juniper

Row 3
Russian mulberry
Catalpa
Green ash
Black locust
Burr oak

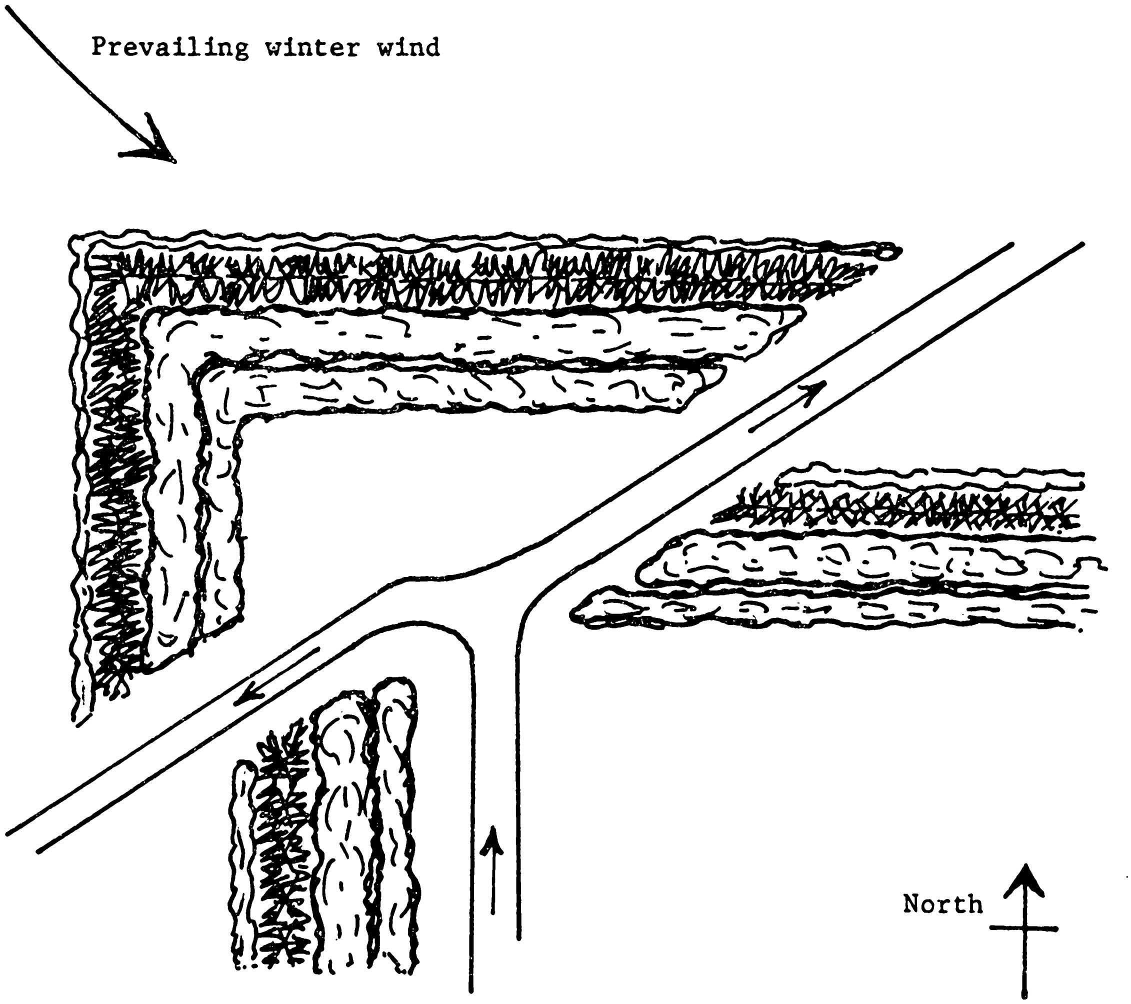
Row 4
Cottonwood
Honeylocust
Hackberry
Silver maple
American elm
Walnut
Chinese elm

Row 5
Russian olive
Redbud
Apricot
Osage orange

Fig. 86. Recommended shrub and tree species for a five row windbreak.

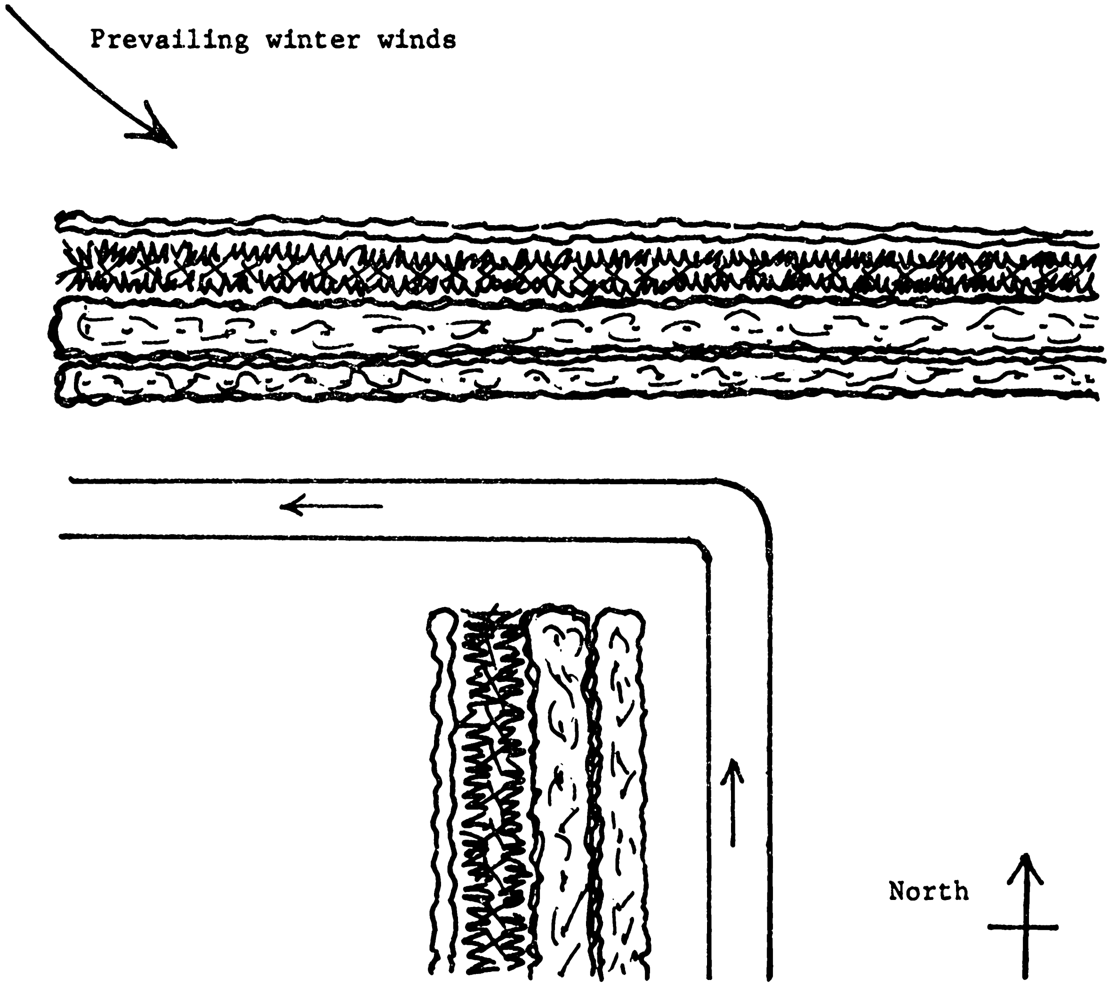
Row 1	Row 2	Row 3
Redcedar	Cottonwood	Russian olive
Austrian pine	Honeylocust	Russian mulberry
Ponderosa pine	Hackberry	Redbud
Scotch pine	Silver maple	Apricot
Rocky mountain juniper	American elm	Osage orange
	Chinese elm	Green ash
	Walnut	Black locust
	Catalpa	

Fig. 87. Recommended tree species for a three row windbreak.



Leave opening in windbreaks where needed for lanes and roads. Arrange plantings to avoid wind-tunnel effect by protecting each opening as shown.

Fig. 88. Traffic opening in tree windbreak row.



Move opening away from corner if possible, and offset rows as shown.

Fig. 89. Traffic opening in tree windbreak corner.

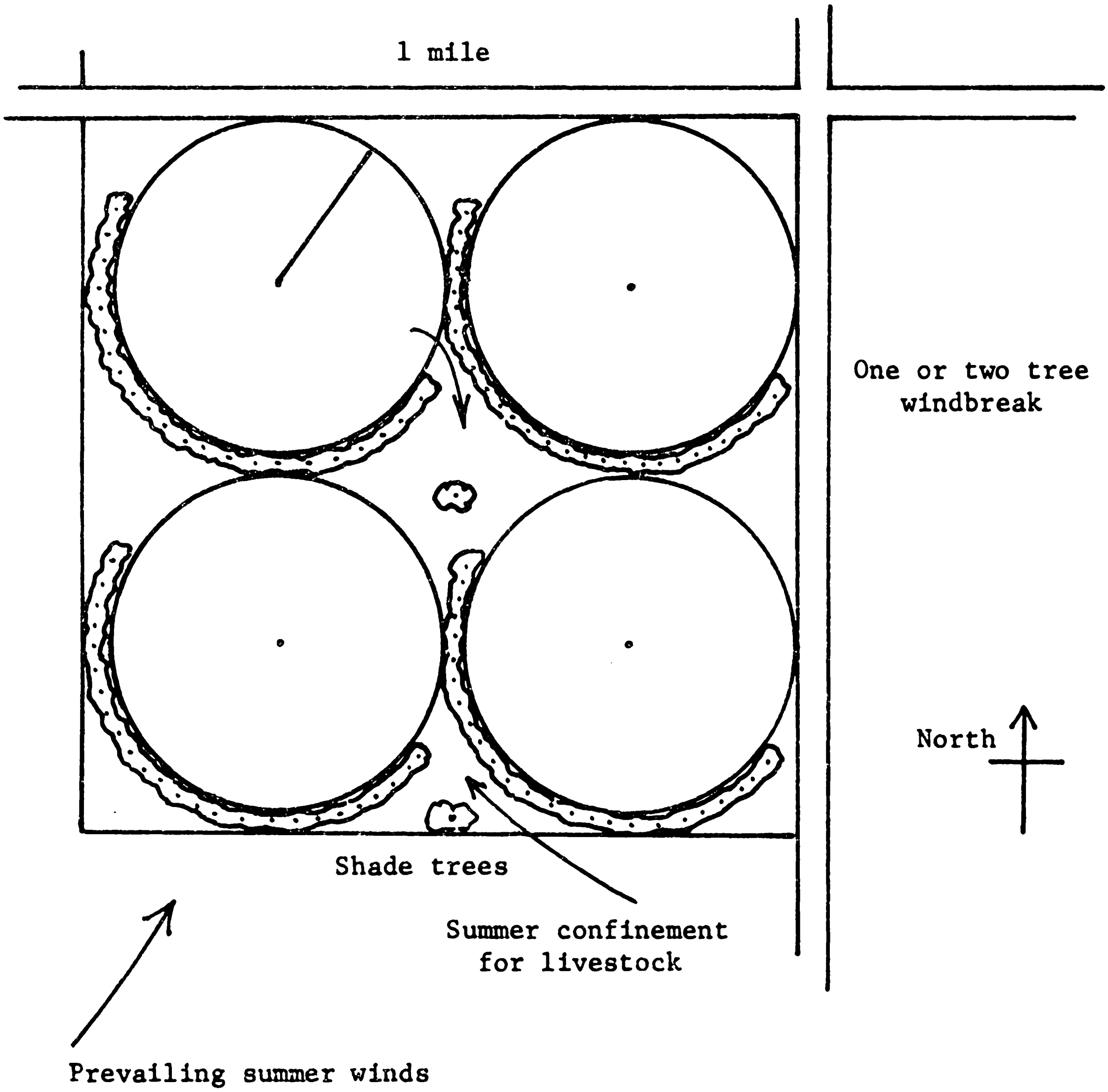
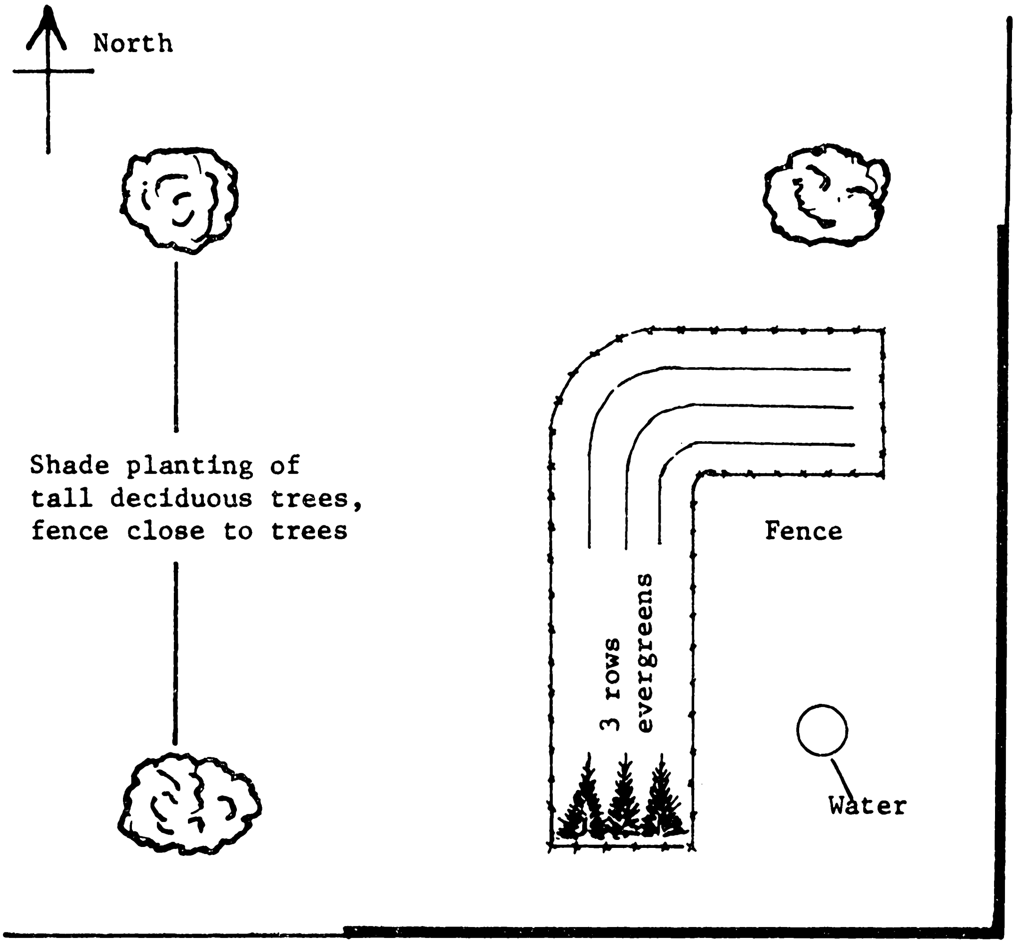


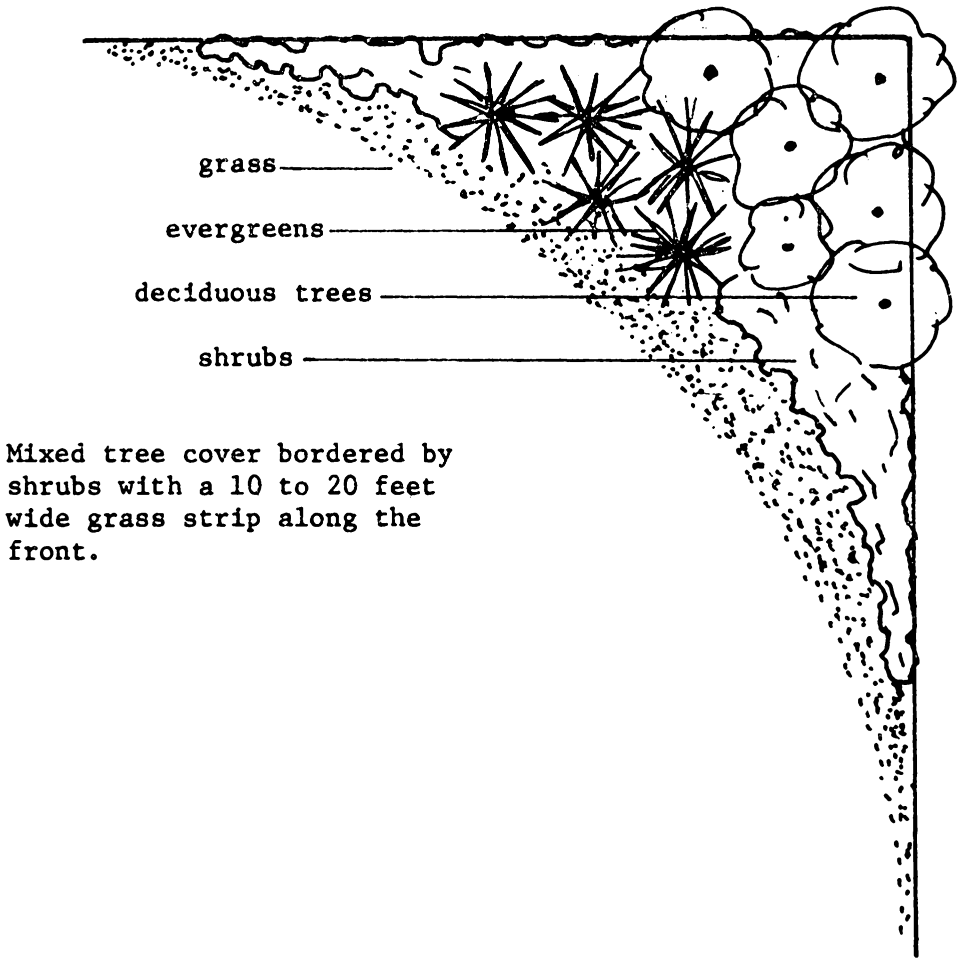
Fig. 90. Four 160 acre center-irrigation systems per square mile showing placement of crop windbreaks and shade tree planting for livestock.



Reinforced fence

Protect all plantings from livestock. This is true regardless of the age of the planting. Livestock if allowed in the windbreak will trample and pack the soil, break or eat small trees and damage lower limbs of large trees.

Fig. 91. Livestock windbreak and small game habitat.



With modern and often large farm machinery many field corners are no longer cultivated. These waste corners can be valuable assets for wildlife and when planted thoughtfully can be esthetically very pleasing. One should try to provide a mixed cover and plant in the form of a pyramid. In many situations there will be two or more corners coming together.

Fig. 92. Planting field corners.

which are often neglected, or are managed in such a way that their land use is not clear, nor is their landscape design.

Where structure or development is approached, more maintenance may be required, and design may be more planned to help tie structure into rural landscape, but an urban effect should be avoided.

Between the rural and the town is the category of the town's fringe, this so often is a very grey and esthetically displeasing area. The town fringe covers a wide range of design and maintenance between urban and rural practices, depending on land use, scale, existing development, and especially what maintenance will be available. Too often the landscape is designed as too urban and where the scale is large and ample space is available, design and maintenance should be more casual and like rural landscape; if the space is large enough, and setting allows it, it can be more naturalistic.

The last category is the natural landscape generally associated with the natural unspoiled wild lands. It is a landscape of which Kansas has only little as most land is managed for agriculture. When these areas are restored, the landscape design should be such that any planting seems natural and represents spontaneous natural growth of grass with its forbs, and shrub and trees with no maintenance. Such a natural landscape is an integrated natural system.

Most of our experiences of the country are gained by driving through it at today's speed of 55 mph where the road is good. Inevitably the scale of the landscape we travel through is larger than the one we live in. Consequently, with the speed and the scale, the landscape remains a view and does not become an intimate experience unless we stop and become part of it by walking through it or sitting down. The large scale rural landscape is for both farming and travel. The small scale town landscape is for living. These are two contrasting environments which should be kept distinct and unconfused.

The establishment of the above four landscape categories with correct use of plant material according to principles of design is so simple and direct and universal, that people with only little training could take leadership roles and start encouraging land owners. Here the Extension agents are in a unique position. The result would be a more interesting and harmonious landscape--a functional regional landscape.

The real difficulty is how any large scale plan is to be applied. Most land in Kansas is owned by farmers and they cherish their independence. Only local people can effectively, under knowledgeable leadership, map the landscape categories found in their region or counties. They can seek out those odd sites which are suitable for tree and shrub planting. The local Extension agent can discuss landscape problems with farmers and town and community people, and explain the idea of landscape regions.

Government bodies in communities can set the example on lands under their jurisdiction. Industrial communities can be encouraged to follow suit so that all landscapes would tie together.

Under this system, all land already has its exact place in the potential landscape pattern. The method of realizing that pattern provides clear and simple specifications for any land in any situation--for the type of landscape to be established, for a planting pattern as part of the landscape framework, for the use of regional species of trees and shrubs, grasses and forbs, and for the style of design and type of maintenance.

The above would provide routine answers for all kinds of landscape problems resulting in a coherent landscape policy, resulting in a functional regional landscape to pass on to future generations. To assist in providing for that future and to provide those answers have been the aims of this dissertation.

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FACTORS INFLUENCING THE USE OF PLANT MATERIAL TO DEVELOP A FUNCTIONAL REGIONAL LANDSCAPE IN THE GREAT PLAINS

Gustaaf A. van der Hoeven

ABSTRACT

This study shows how the natural landscape of a region--the Great Plains--evolved over a long period of time through natural processes and was modified in a relatively short period, approximately one hundred years, into a cultural landscape. With understanding and appreciation of the processes involved, such landscapes can be used as a basis to restore and maintain a functional regional landscape.

A case study of Kansas and a summary of information for people responsible for the landscape is given so that their efforts will result in a landscape which is ecologically sound and esthetically pleasing.

The dissertation is concluded with an inquiry into the practical feasibility of national landscape parks and a theoretical outline of the methodology for creating a functional landscape.