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From Horse to Horsepower : Farm Tractorization and the Rural Landscape in Minnesota and Surrounding States

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FROM HORSE TO HORSEPOWER:
FARM TRACTORIZATION AND THE RURAL LANDSCAPE IN MINNESOTA AND SURROUNDING STATES

by

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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> I went in serach of my art, often in danger of my life. I have not been ashamed to learn those things which to me have seemed useful, even from vagabonds, barbers, and executioners. For we know how a lover will go a long way to meet the woman he loves. How much the more, then, will the lover of widsom be tempted to go in search of his Divine Mistriss. (Truth)

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TABLE OF CONTENTS

List of Figures

List of Tables

List of Maps

CHAPTER I

INTRODUCTION

Mankind has been modifying the face of the earth ever since the dawn of humans (Sauer, 1962). The changes wrought by human activity have become a major focus of geographic research in an attempt to understand mankind's cultural imprint upon the landscape and how humans have modified the physical environment. It is within the scope of cultural geography to study the interactions of them both (Gritzner, 1966: 6). This study is presented from the perspective of a cultural geographer.

"From Horse to Horsepower: Farm Tractorization and the Rural Landscape" examines man's imprint on the land due to changing farming technologies in the American Midwest. Specifically, during the transition between the "horse era," when horses were the primary power source of agricultural power, and after tractorization took place--that is, when horses were displaced by tractors.[1] This thesis examines transformations within the cultural landscape due to significant technological changes on the farm. Aspects involved encompass the broad topic of the "rural landscape," elements of which include fields, farm buildings, farm equipment and implements, farmsteads, rural roads and bridges, crops, fences, and the general history of the mechanization of agriculture, deliberate manipulation of the environment for mankind's ends, that is, to provide food, fiber, and shelter. For purposes of this study, the landscape may be divided into urban and rural components. The rural landscape is the focus of this study.

This study does not attempt to cover all aspects of the rural landscape; rather, it will focus on the farm and its related elements. The rural-urban "fringe" is relevant only insofar as it illustrates the dynamic interaction and interdependence between the rural and urban boundaries. These boundaries pose a threat to the preservation of much of our rural cultural heritage, as many of the old farm buildings and other rural relics are being torn down to make way for factories, housing projects, and shopping centers. The urbanization of rural society is beyond the scope of this study, as many scholars have dealt adequately with this topic. The farm community is necessarily connected to urban centers for transportation, marketing, financing, electrical supply, and various other serivces. Ties between the rural and urban communities are much stronger today than they were during the "horse era" when farms were largely self-sufficient.

Ignorance of our rural past increases with time as more Americans are removed from their rural roots, hence, there is an urgent need to study our past before it is lost to us forever. Specific reasons for such a study include the following factors:

1. The impact of farm tractorization on the rural landscape has been inadequately studied from the geographic perspective. Farm mechanization came about due to deliberate efforts and choices by inventors and innovators. Rural Sociologists, Historians, and Agriculturalists have conducted many studies of rural industrialization, rural life, rural ways, crops and livestock, and the historical setting for mechanization. Little synthesis of such data from these and other disciplines has occurred, however, to date. One objective of this study is to provide such synthesis from the viewpoint of cultural geography.

2. Historical preservation efforts rarely extend to farms, farm buildings, or other rural "relics" on the landscape. State historical museums attempt to reconstruct the past in "living history museums," but such efforts are simply unable to recapture the "flavor" of the past. In such settings, the context is lost. It can be partially regained, however, through geographic research and analysis.

3. There is great relevance to the study of the substitution of horses by tractors and other power equipment because so much of our lives were affected by decisions made during this transitional era. The men and women who remember life during this earlier era are passing away; the farm structures, tools, and machines are falling into disrepair and ruin. The patterns of their imprint upon the land are being erased by "modern ways." While this study is not concerned primarily with buildings, structures do serve to remind us of an age of innovations and experimentation. Those who recall the old home place before the advent of tractors often can still remember the excitement of getting their first Mogul-Titan, Fordson, or Case tractor. They can still recall the "miracle" of being able to use a tractor to do a week's work in one day. They recall the problems and pitfalls of being innovators. Little do we appreciate the vast difference tractorization made in their

day-to-day lives. This thesis explores those aspects of farm tractorization and how it changed "work" and the landscape.

4. It is imperative for us to understand the rural landscape and its gensis in order to understand the present. The geographer, Erhard Rostlund in Outline of Cultural Geography (1955, 4) states, "The present is the fruit of the past and contains the seeds of the future." By understanding the rural landscape as it was in the 1880s and the changes wrought due to the advent of farm tractorization, we can know more of ourselves. With the knowledge of our past, we can understand better how our cultural ways will lkely affect the rural landscape in the future. The "seeds" of our rural cultural landscape have grown to maturity in our current blossoming of agricultural productivity, due chiefly to changes in agricultural technology. The rural landscape is not just scenery through which we pass on our way from city to city. It tells us a story about ourselves if we learn how to read it. It is not necessary to know the names of every weed or the typology of each barn in order to appreciate the countryside. "From Horse to Horsepower . . ." will investigate the changes in farming technology that eventually led to the "factory farm," to Harvestore silos, and other material cultural traits of our present rural landscape.

There is need for a coherent understanding of the scope and importance of the introduction of farm machinery, particularly the tractor, into the rural landscape. The research problems and questions addressed in this study include:

1. How did farm tractorization change the rural landscape?

2. What was the extent of those changes in terms of their micro vs. macro impact upon the landscape and were the effects immediate or latent?

3. How did the change from using horses to using steam or gas powered tractors affect the rural landscape during the transitional period between the 1880s and 1930s?

4. What changes in the landscape occurred from the 188Øs to the present due to "tractorization" (substituting tractors for horses)?

5. What changes occurred in the Midwest generally and in Minnesota specifically as a result of the technological transition?

6. What specific changes occurred in the size of farms, farm buildings and their uses, the layout of farmsteads, farming practices, or other important aspects of farms and farming?

7. How did the evolution of inanimate "power" to do work on the farm affect the rural landscape?

"From Horse to Horsepower. . ." provides a perspective on the cultural geography of farm mechanization, particularly documenting those changes in the landscape that resulted from "tractorization." Tractorization is the main focus of this thesis because it was the primary form of power machinery adopted by farmers. Other powered farm machines and implements played secondary roles in the mechanization process.

Farm mechanization not only was a historical event, but is an ongoing process as new technologies are developed. The history of farm mechanization is of interest because of its relevance to us. In order to understand that relevance to our material cultural heritage, we must know what has changed or remained the same over time.

The central hypothesis of this study is that the rural landscape was dramatically transformed due to the displacement of horses by tractors. Additionally, the initial changes in farming practices led to the demise of some distinctive material cultural traits of the rural landscape, while they gave rise to others. Part of the purpose of this study is to delineate those traits which were particularly significant, to show how those traits were adopted or dropped over time, and how they fit into the rural landscape. Form and function of machinery, buildings, and work itself are the signficant features that are reflected in the landscape, hence, they are the elements studied in this thesis. One purpose of a thesis is to add to the "body of knowledge." "From Horse to Horsepower: Farm Tractorization and the Rural Landscape" does so from a cultural-geographic perspective by showing how this aspect of our cultural ways have dramatically shaped the rural landscape.

Terminology

Definitions of key terms used in this study appear in the glossary. In the title "From Horse to Horsepower: Farm Tractorization and the Rural Landscape," several terms need precise definition because of their importance to this study. "Horse" refers to that animal's ability to work, that is, to provide "power" (the specifics of "power" will be more fully discussed subsequently). "Horsepower" refers to ". . . a measure by which the capacity of engines is rated, established by Boulton and Watt at 33,000 pounds raised one foot high per minute" (Ripley and Dana, 1874: 830). There is another meaning of "horsepower" which appears in the glossary. "Farm" is an unambiguous term and refers to the fields, farm structures, and so forth, generally understood to be included in agricultural production. "Tractorization" refers to the process of changing from using horses as the primary power source, to using tractors. "Rural" includes all that is not urban. Since such a definition is too broad for the purpose of this study, the term rural is restricted to farms and the land used for farming purposes which surrounds farmsteads. It includes spaces between urban areas used for agricultural purposes, lying fallow, or otherwise generally considered to be farmable land. Roads, railways, and waterways also are included. "Landscape" refers to the natural landscape as modified by man's cultural activities. Carl O. Sauer's (1963: 343) definition of cultural landscape is particularly pertinent in this context:

> The cultural landscape is fashioned from a natural landscape by a culture group. Culture is the agent, the natural area is the medium, the cultural landscape the result. Under the influence of a given culture, itself changing through time, the landscape undergoes development, passing through phases, and probably reaching ultimately the end of its cycle of development.

Philip Wagner and Marvin Mikesell (1962: 11) offer an equally applicable definition of "landscape":

> The cultural landscape . . . is a concrete and characteristic product of the complicated interplay between a given human community, embodying certain cultural preferences and potentials, and a particular set of natural circumstance.

In surveying the rural landscape's material cultural traits, the tangible elements or artifacts of rural culture itself are of particular interest. Examples of such traits include barns, sheds, silos, bins, machines, tools, and so forth. Material cultural traits are the products of ideological, sociological, or technological aspects of a culture. Traits are identifiable by their form, function and value. Those changes in traits resulting from "tractorization" and (general agricultural mechanization) are of central concern in this study.

<u>Limitations and a Review of the Pertinent Literature</u>

This study is limited somewhat by the lack of an extensive body of literature pertaining to the impact of motorized implements on the landscape. Most authors who have addressed this subject have done so only in a peripheral context, secondary to a more salient topic. Such references as do exist often reflect the narrowly specialized interests and backgrounds of the respective authors; hence, information is narrow in scope and lacking in synthesis that is so vital to a comprehensive overview of the impact of tractorization on the cultural landscape. Examples include numerous highly specialized articles pertaining to types of machinery, farm buildings, the role and importance of mechanization, and various agricultural practices. Only one published work, Tractorization (Sargen, 1979), was found which specifically addresses the role of tractorization in altering rural landscapes. Even this volume focuses primarily on the diffusion of the tractor in the United States and why farmers were willing to adopt them. It is not a study of the rural landscape, per se, and it is highly technical in nature and therefore is of limited value for the purpose of this research.

The impact of farm mechanization on the land has not been adequately studied from the geographic perspective. Landscape itself is a relatively new area of research. During recent decades, an increasing number of geographers have studied agriculture, barn types, farmsteads, and rural settlement in the United States, among other topics. Geographical literature pertinent to this study includes: Atlas of Minnesota's Resources and Settlement (Borchert and Yeager, 1968); "The Middle West"

(Hart, 1972); "The American Dairy Region" (Durand, 1949); "Agricultural Production in the United States: The Past Fifty Years and the Next" (Harris, 1957); and "Agriculture in Minnesota" (Miller, 1916). Of these, Hart's article was the most interesting and useful concerning the landscape and the history of settlement, crops, and mechanization.

Many articles about barns have been written by geographers. These include: "Some Regional Characteristics of American Farmsteads" (Trewartha, 1948); and "Distribution of Barn Types in Northeastern United States" (Noble and Seymour, 1982). Other studies of regional types of barns have been conducted but none is as useful as Noble's, which includes a typology of barns. Trewartha's article included a section on houses and barntypes, and was lengthier and of greater general usefulness than Noble's article. Trewartha conducted a comparative study of the types of farmsteads in the Northeastern United States. In that study he also identified types of structures on farmsteads, such as, garages, hog houses, machine sheds, corn cribs, wood lots, windbreaks, silos, windmills, and others.

Studies by geographers on farms and farmsteads include: "Economics of the Long Lot Farm (Barnes, 1935); "Rational and Ecological Aspects of the Quarter Section:

An Example from Minnesota" (Johnson, 1957); "Fragmented Farms in the United States" (Smith, 1975); and again, Trewartha's article, "Some Regional Characteristics of American Farmsteads." Of these, Johnson's article is valuable because it suggests that national land policy and legislation left its distinctive imprint upon the land. Smith's article dealt with farm fragmentation and the size of tracts which farmers are willing to farm due to high cost of land today. All of these issues are a part of the total picture of man's imprint upon the rural landscape.

Articles and books by non-geographers are of special significance because they often provide the only available data on certain aspects of farm tractorization, agriculture, and the farmstead. Those of special interest include: The Tractor (Currie, 1916); Power and the Plow (Ellis and Rumely, 1911); The Agricultural Tractor 1850-1950 (Gray, 1975); Farm Power in the Making of America (Johnson, 1978); Old Time Agriculture In the Ads (Karolevitz, 1970); Tractorization (Sargen, 1979); Farm Gas Engines and Tractors (Jones, 1938); Barns, Sheds and Outbuildings (Halsted, 1978); American Barns and Covered Bridges (Sloane, 1954); Agricultural Buildings and Structures (Whitaker, 1979); and Changing Rural Landscapes (Zube and Zube, 1971). For an understanding of "landscape," J.B. Jackson's The Necessity for Ruins, and Other Topics, and Carl O. Sauer's "The Morphology of Landscape" (1925) are appropriate sources.

The topics of the above mentioned books are self-explanatory. Of greatest historical interest are those books from the early twentieth century when the change-over from horses to horsepower occurred.

For added historical flavor are numerous anonymous articles debating the adoption of tractors, found in The Gas Engine, a journal dating from about 1900. The articles are a treasure trove insofar as they capture the perspective and the context of those early days of tractorization.

As can be readily seen, the problems associated with integrating material from a broad range of topics is one limitation of this study. The fact that relatively few landscape studies have been conducted is another. We can only gain insight into the probable cause and effect relationship between farm tractorization and the changes in the rural landscape that occurred. To attempt a detailed comprehensive review of each factor involved in this broad subject matter would be prohibitive in a thesis and is more appropriately reserved for book length review. It is sufficient that the literature cited in this paper offers evidence of the impact of tractorization on the landscape.

A review of the literature provides an understanding of the historical process of mechanization (history of technology); of the farmers' attitudes toward it (sociology); of farming methods and practices applied to the land (agriculture); and of those combined elements which impart distinct characteristics to rural landscapes in a spatial context (geography). Geography seeks to bridge these disciplines; cultural geography, based on Carl Sauer's methodology, seeks to explain "what, where, and why" in order to understand the evolution of the landscape. "From Horse to Horsepower . . ." discusses the beginnings of power use on the farm, its forms and functions, and the imprint that tractorization made upon the rural landscape. It will attempt to explain what occurred, where, and why, and the significance of all of these. By so doing, the rural landscape will become clearer to us and we will discover more about who we are and how we came to be where we are today.

CHAPTER II

THE HORSE AND STEAM ERAS

Historical Background

Prior to the 188Øs most farm work in America was accomplished by manual labor or horse power. The rural landscape of the time was still very pastoral.
It was an agrarian age, though an era soon to be altered by the transition from horse to steam power. The "horse era" would finally yield before the onslaught of the Industrial Revolution in American agriculture. The "horse era" was characterized by a reliance on horses (as well as mules and oxen) for the chief power source on the farm.

The American family farm would first feel the ripples, then the tidal wave of a new "mechanical age" in farming. However, during the "horse era," the family farm was still largely a subsistence enterprise:

> The typical pattern of agricultural settlement in the United States involves isolated farmsteads surrounding a trade center. The family lives on its own farm in a house ordinarily surrounded by outbuildings including the barn . . . chicken houses, or other structures as required by the type of farm enterprise. In very large areas of the country, particularly in the agricultural Middle West, isolated farmsteads are laid out in a rectangle (Slocum, 1962: 116).

The subsistence farm was characterized by the family living on the farm and growing food and fiber for their own consumption. Standard features of the subsistence farm of 1880 included:

> . . . the contiguous fence-enclosed farm whose focal point is the farmstead with its single-family dwelling. This arrangement, involving compact farms, fenced fields, and isolated farmsteads, stands in contrast to another system, European, where scattered noncontiguous unfenced fields, and farmsteads clustered into rural villages, are the rule (Trewartha, 1948: 169).

The contrast between the Western European rural landscape and the Middle Western American countryside is due largely to the historical and cultural traditions that developed in the expanding new nation. "In the traditional order of things . . . the ideal was that the family who owned the land also lived on it and worked it" (Jackson, 1980: 120-121). This philosophy toward the traditional order in the United Staes was reflected in Thomas Jefferson's ideology which he nurtured after becoming President in 1800. The Jeffersonian ideology still pervaded the Midwest in the 1880s:

> For Jefferson the men of the eighteenth century who championed small farms, the reasons were largely political and . . . sociological: freedom, independence, self-reliance, ability to resist oppression-these were the qualities . . . that most

> impressed Jefferson (Rodefeld, et al, 1978: 130).

Thomas Jefferson supported legislation that would facilitate quick settlement of the land. Subsequent legislation governing the alienation of land was based on Jefferson's concepts:

> A . . . principle that was not implicity contained in the acts (referring to the Ordinance of 1785, 1796, 1800, 1804, 1820, 1832, General Instruction of 1855, Homestead Act of 1862) was the idea of complete settlement of the land (Johnson, 1974: 15).

By adopting the Jeffersonian ideal of the family farm, public policy was, in effect, following Jefferson's belief in farming as an admirable vocation as well as a "way-of-life." Jefferson reasoned that freedom included the fundamental right to own land. The Ordinance of 1785 and subsequent land policies made this possible for ex-soldiers returning home form the Civil War and for the thousands of new immigrants who needed jobs and homes. Jefferson's philosophy saw its culmination in the Homestead Act of 1862, signed into law by Abraham Lincoln. The Homestead Act promulgated the ideology of the family farm, as was manifested in the Midwest:

> The ideology of the family farm appears to be founded on four basic sentiments: 1) each farmer should own the land he farms; 2) each farm should be large enough to provide a decent living; 3) the farmer and his family should do most of the work; and 4) they

> should receive a fair price for their products (Hart, 1972: 271).

In the Midwest, the combination of historical factors such as immigration, the Homestead Act, the Ordinance of 1785, and Jeffersonian ideology, influenced how farmers settled upon the land; that is, affecting the likelihood of their adopting power-machinery and, hence, modifying the rural landscape to a much greater degree than in the past. The rectangular survey strongly dominates the "look of the land" in the Midwest, especially in the grid pattern visible in towns, section lines, and even field patterns (Johnson, 1974: 12).

> . . . the size of farms in the Middle West continues to be significantly influenced by the minimal acreage of land that had to be purchased. The limited evidence available indicates that the size and boundaries of farm ownership units remained remarkably stable from the date of alienation until the start of World War II (Hart, 1972: 264).

In the case of the Ordinance of 1789 and the Homestead Act, the imposition of the quarter-section concept on the land is of particular interest, since a rectangular imprint on the rural landscape was the result. The quarter-section has had considerable impact on farm practices subsequently employed. Often it was inappropriate to the physical geography of a particular area to have boundaries which followed a man-made scheme of straight lines superimposed on curving, hilly terrain. Farmers, for example, have been known to plow straight up and down steep slopes, ignoring the potential for erosion:

> When men plowed straight up and down a hill, it did not occur to them that the next rain might wash half the earth off it, right down the furrows, and that after several rains the hill would be a bare and useless place where nothing would grow (Helfman, 1962: 36).

The "quarter-section" on paper simply ignored differences in terrain, soil types, natural waterways, and the presence of natural obstacles in fields. The unnatural straight lines and grids did not help the farmer:

> The tiller of the soil has to work with soils, trees, slopes, stones, creeks, all of which are irregularly distributed.
>
> He cannot ignore or control them but must adjust to them, and adjustment means curves and irregular clearing (Johnson, 1957: 347).

The motivating force behind the imposition of the grid pattern on the land was to encourage complete settlement of the land. "Alienation" refers to the dispensing of public domain by selling the land, or by allowing free or nearly free homesteading:

> The overriding intended function of the formal plan was to facilitate fast disposal of the land and to guarantee property rights by easily understandable nonambiguous description (Johnson, 1974: 13).

The alienation of land by legislation led to farm sizes of 160 acres or less in most instances in the Middle West. Restrictions on the maximum acreage available to the farmer made larger farms less likely, except by "amalgamation" of a 160-acre contiguous farm (Hart, 1972: 274). "Accretion" usually consisted of adding an 80-acre or 40-acre tract to an existing farm. According to Hart's "The Middle West," amalgation was the more common means of increasing farm size (Ibid: 272). The impact of legislation of farm size is evident in the Midwest:

> As the number of farms increased, their average size declined from 1850 to 1910 because of the impact of the Homestead Act, which until 1909 restricted the granting of more than 160 acres to an individual (Drache, 1976: 5).

The sizes of farms, as well as the physical geography, was extremely important when mechanization came to the Midwest with the advent of mechanical power-generation. Since the landscape is the focus of this study, an understanding of the affects of public land policy on the look of the land will clarify the subsequent affects of tractorization.

A persistent image of the Midwestern farms as forming a checkerboard pattern on the land is popular, but unfounded. Though there is a rectangular look to fields and farmsteads, there is little evidence of the much-touted checkerboard pattern:

> The common notion of the Middle West as a checkerboard of 160 acre homesteaded farms divided into four square 40-acre fields has little basis in fact (Hart, 1972: 263).

A typical Midwestern farmer of the 1880s would more likely have described his landscape as crazy-quilt, depending on where he lived and on the local topographic conditions. The grid-pattern survey system influenced rural settlement patterns, the siting of the farmstead, the orientation of farm buildings, field patterns, plowing practices, field sizes, siting of rural roads along section lines, and straight-line cultivation in many areas. These are by no means the exclusive affects wrought by the imposition of the "quarter-section" in land disposition.

The quarter-section of land owned by one farmer could have advantages lacking in the neighboring section, affecting that farmer's ability to prosper and, by implication, to mechanize:

> One man's quarter-section of one hundred and sixty acres, the standard square homestead . . . might have the luck of good soil, a creek, and a few shade trees. But another man's sixteen hundred acres might be as hard as cement and barren of all shade and water (Cooke, 1973: 254).

When power machinery came to the farm, the ability to take advantage of mechanization could very well depend upon the pre-existing advantages of soil, terrain (with special preference for flat ground), field sizes, and the general prosperity of the farm. Subsistence farmers could hardly expect to mechanize. Before mechanization could occur, a set of pre-conditions were necessary: adequate soil fertility; a good and reasonable set of farming conditions; a healthy farm economy; and access to reasonable financing.

Prospective farmers found an abundance of good virgin land in the Middle West. By 1854, most land had sold for $1.25 an acre:

> In 1863 . . . most of the better land in the Middle West had already been purchased from the General Land Office, and precious little remained free for the taking in farms of 160 acres. Minnesota was the only state in the Middle West in which any significant amount of good farm land was homesteaded, although seekers after free land did pick over the carcass in the boreal forest to the north . . . (Hart, 1972: 263).

Whether homesteaded in 160-acre tracts or less, or brought from the General Land Office, an incredible amount of land was settled before 1900:

> Between 1860 and 1910 more than 781,000 square miles of new land, an amount equal to more than one-fourth of the total area

> of the United States, was brought under cultivation. The number of farms in 1910 was 6,000,000, a figure triple that of 1860 (Meine, 1950: 374).

Considering that horses were still the predominant power source on the farm, such figures are astounding in that they indicate the great chore of breaking the virgin sod. With so much work to be done--amd considering the slow pace of farm work using horses--farmers were more than ready to experiment with machinery, once it was proven that it was economically to their advantage to do so. The fact that so much land was opened for cultivation set the stage for the coming of the "power" revolution on the farm.

Farming With Horses

Farm work was backbreaking drudgery as farmers followed the old horse-team behind the plow. Despite the advent of the steel plow (1833), work was slow since horse and man required frequent food, water, and rest stops. The workday included feeding the livestock, "breaking" or harnessing horses, plowing or threshing, hauling crops to market or storing them, and making repairs on equipment, buildings and fences.

The work of the farm family produced food, fiber, and shelter for them. If the family was lucky, thrifty, and hard-working, it might end up with a marketable surplus. If not, the family sufficed with what it had, and bartered for what it did not. Those who were engaged in mixed farming, that is, grwoing products for themselves and their livestock, were better able to make the gradual transition to commercial farming:

> As commercial farmers shifted from animal power and began making use of a steady stream of improved farm machines, they and their families found they could handle larger acreages of crops and care for greater numbers of livestock. This is the essence of the process of consolidation of land into fewer commercial farms, which has progressed through depression and prosperity (Rasmussen, 1975: 2923).

The transition to commercial farming had definite impacts upon the rural landscape and will be discussed later in this study. More intensive cultivation of the land, monoculture, and a general rise of land values are some of the impacts of that transition.

The intesification of cultivation was made possible by using types of labor-saving machinery which became available after the Civil War. As a result, non-powered machinery supplanted some manual labor and increased man's reliance on the horse as his main power source:

> The decade of the 1860s saw many improvements in farm machinery, as well as the more general use of implements by the farmers. The fact that the Civil War resulted in a scarcity of labor stimulated the adoption of machinery (Jarchow, 1949: 131).

The impetus to mechanize was stimulated by the war (and by subsequent wars), which took productive land out of practical use and robbed farms of their labor force. The trend toward mechanization led to a transition from diversified agriculture (typical of the subsistence farms), to specialized farming (typical of commercial, industrialized farming).

Diversified agriculture characterized most Midwestern farms during the "horse era." Even without machinery, farmers were able to clear land for their homesteads, but the pace of the work was decidely slow; about one acre per horse per day was average in a ten-hour day (Sargen, 1979). Of critical importance to an understanding of the tendency to accept power-driven machinery was the cost of labor in man-hours:

> The pioneers [in Minnesota] had to clear away the Big Woods to make room for fields and pastures. They cut down the trees, pulled out stumps, and hauled away the wood . . . they did it with no machines and few tools (Borchert, 1959: 45).

Some farmers were still enmeshed in an advanced plow culture little changed since Babylonian civilization, except that the plow was made of steel rather than wood, and horse labor had replaced human labor in front of the plow. Many inventors recognized the farmers' need to raise their crops and livestock with less cost and drudgery than is required using human or animal labor. The Industrial Revolution in England led to the stimulation of similar innovations and investions applied to agricultural problems. Many machines were invented by the Civil War period; they greatly alleviated the burdensome farm workload:

> The major inventions in farm mechanization that occurred from 1830 to 1850 are: the reaper, 1831; the steel plow, 1833-1837; the combine, 1836; the threshing machine, 1837; the two-row corn planter, 1839; the grain drill, 1840; the wooden hand pump using suction to lift water, 1940; the grain elevator, 1842; the first American incubator, 1844; the one-horse wheel cultivator, 1846; push-type headers, 1848; hand dump rake, 1850 tractionless but portable steam engine for farm use, 1850 (Drache, 1976: 3).

These tools and machines were specialized for some of the most time-consuming of farm tasks, and in some cases they made the productivity of the farm much greater and more efficient. The changes in productivity per man-hour encouraged ties to a market economy, which affected the rural landscape by linking isolated farmsteads to local service centers, marketplaces, and manufacturing centers. Plowing, cultivating, planting, harrowing, pulling stumps, and moving non-self-propelling equipment were some typical farm tasks requiring horses. Before self-propelled tractors were invented, horses were a necessity on most farms, but they were also costly and time-consuming:

> The following authentic record of a field of corn in Ohio up to the point of harvest shows the distribution of labor in terms of one horse's time:

	Horse Hours	Percent
Plowing	13.20	31.20
Disking	3.86	9.10
Harrowing	4.14	9.77
Rolling	1.15	2.70
Dragging	5.38	12.70
Planting	1.84	4.35
Cultivating	12.79	30.18

> (Ellis and Rumely, 1911: 269).

Following the example in England, American inventors applied their efforts to finding an efficient mode of power generation in order to cut farmers' cost and work load. Many of the inventors were farmers themselves, hence, they appreciated the effectiveness of a tool that made work easier. Of course, if work was easier, less time-consuming, and more efficient, inventors would find a ready and willing market for their products. Many progressive farmers foresaw the eventual substitution of steam power for horse-power for farm work:

> The prejudice in favor of the horse is passing. Men have accepted the new order of things, and the problem now is to adapt mechanical power and farm methods to one another in the way that will give the most useful results (Ellis and Rumely, 1911: 240).

Ever since Thomas Jefferson, American leaders recognized the wisdom of promoting the health of the agricultural industry. Abraham Lincoln supported the coming of the mechanical power revolution in agriculture, which was launched by the stationary and portable steam engines. Culturally, the nation's farmers were ready for the oncoming revolution in farm work, which partially explains its rapid adoption. Additional promotion by Lincoln spurred the ready acceptance which steam power recieved:

> The successful application of steam power to farm work is a desideratum--especially a steam plow. It is not enough that a machine operated by steam will really plow. To be successful, it must, all things considered, plow better than can be done by animal power. It must do all the work well, and cheaper, or more rapidly, so as to get through more perfectly in season; or in some way afford an advantage over plowing with animals else it is no success (Rasmussen, 1975: 3414).

Inventors such as A.L. Archambault, Henry Ames, Obed Hussey, and J.W. Fawkes worked diligently to perfect a steam engine capable of meeting the criteria set forth by Lincoln. With the President of the United States urging the adoption of steam power, the debate over whether to use animal power or mechanical power was luanched.

Using a horse, a farmer could work from eight to ten hours a day, if the horse was well-fed and healthy. A typical Midwestern farm in 1880 could expect to shelter, feed and care for an average of six horses, depending on the size and type of farm:

> Six working horses are kept on the average 160 acre farm. The feed for these horses in a year approximates the yield of 30 acres or a total of $527.24 in cash. With 100 acres under cultivation, which is the average number on a 160-acre tract, this leaves 70 acres to offset the cost of harness, care and shelter (The Gas Engine, 1916: 190).

The spatial consequences of using horses for farm work include the requirement of five acres per horse for raising oats, hay, and other feed, or about 12,000 pounds of feed annually. Acreage used in raising horse feed could not be used to raise a cash-grain crop. In effect, acreage devoted to raising horse-feed was non-productive. Using horses also required that the farmstead have a large barn with a hayloft, and pastures for grazing and exercise of horses. To operate the farm, a considerable amount of equipment was also required, as is shown in Table 1.

This list of equipment was typical of that needed on an average 160-acre farm with 100-acres under cultivation. Altogether, the costs of equipment, shelter for animals, and sheds for equipment storage, constituted

Table 1

EQUIPMENT NEEDED IN 1882 ON A 160-ACRE FARM

Three horses at $150 each	$450
One pair of oxen	100
One sulky three-horse plow	50
Two-horse cultivator	30
Three-horse reaper (self-binder)	275
Two-horse harrow	15

Source: Jarchow, 1949: 183.

(Since the average farm had six horses, the costs for horses should be doubled).

a considerable investment, as is reflected in census figures. Using Minnesota as an example, Table 2 shows the increase in value of both farmland and buildings from 1850, when horse and manual labor provided power, to 1910, when steam power peaked.

Equipment which farmers used was adapted to use with horses; hence, one would think that farmers would have been reluctant to experiment with a power-source that made their equipment obsolete. With power machinery, most of the equipment previously used with horses was simply pulled by the steam engine, albeit awkwardly, until implements were invented specifically for tractor use.

Farming With Steam Power

Farmers were willing to experiment with steam threshers and tractors because "power" was the key to efficiently "turning" the millions of acres of stubborn prairie sod:

> Power controls our modern world, and since the dawn of history it has been the dominating influence in the transition from savagery to civilization. The human race has always required power for three essential purposes: tilling the soil to grow food and raw materials; changing the shape of materials to adapt them for use; and carrying men and products from place to place. In other words power is required for agriculture, manufacturing, and transportation (Ellis and Rumely, 1911: 274).

Table 2

VALUE OF FARMLAND AND BUILDINGS IN MINNESOTA: 1850 - 1910 *

1850	(data unavailable)
1860	28
1870	78
1880	194
1890	340
1900	670
1910	1,262

* in millions of dollars

Source: Bureau of the Census, Washington, D.C., 1975, _Historical Statistics of the United States_, 1975: 464.

Farmers saw the costs and slow speed with which they could farm using horses. Hence they were ready for the "power" revolution. In changing from using horses to using steam power, farmers could till the soil more efficiently, reshape the landscape, increase farm size, and apply mechanical power to other operations requiring belt power. "Power" refers to "The rate at which work is done. In other words, power involves the time element" (Jones, 1938: 353). Using horses, the pace of farm work was slow (only one acre per horse per day), and there were limits to the ability to increase horses' productivity. The acreage per day plowed decreases with five or more horses working (Sargen, 1979). The economic costs of using horses also could be weighted in terms of contrasting the potential for improving the work-capacity of the horse:

> An improvement in the horse . . . must be painfully slow, but the mechanical genius of man knows no speed limit. An improvement of 20 percent in the horse would take years, but the mind of one inventor may at any time increase the economy of the tractor 10 or even 20 percent (The Gas Engine, 1912: 252).

Mechanical inventions such as the steam traction engine and steam threshers, changed the total power output possible on the farm, hence greatly enhanced the potential for changing "work" and as a result the landscape:

> Mechanical power has added tens of millions of bushels yearly to the yield of prairie wheat and put hundreds of prosperous towns on the map. Prairies are now settled in months where it took years before the coming of the traction engine. The Man with the Hoe is passing, and in his wake, man's faithful friend the horse (Ellis and Rumely, 1911: 11).

Steam threshers were forerunners of the fossil-fuel powered tractor, generally referred to as "tractors," to distinguish them from "steam-tractors." Early steam threshers were huge machines whose practical use was feasible only with the opening of the great prairie lands of the Midwest. The steam machines had many drawbacks, not the least of which was their tendency to explode:

> Many is the time that the steam boiler has exploded on the farm for the want of water, a join weakened by rust, or a stuck safety valve (The Gas Engine, 1911: 158).

The steam machines were cumbersome monsters weighing two-tons or more, which badly compacted the soil. They also required as much as twenty barrels of water a day, were unpredictable, and required large fields for their efficient operation.

The weight of the steam engines proved excessive for many rural bridges and many collapsed as a result:

> With the heavy steam traction engines, it is dangerous and sometimes impossilbe to cross the average bridge on country roads without breaking through, and the careful operator always carries planks with his outfit and planks the bridge ahead of the engine (The Gas Engine, 1911: 158).

(See Figure 1 for a better understanding of the problem farmers faced when moving their steam engine tractors from farmstead to field.) One result of using steam powered tractors was the impetus to construct better and stronger rural bridges. Knowing the hazards of crossing a rural bridge, the "tractioneer takes his life in his hands, and often is heavily liable as well for damage to the structure" (Ellis and Rumely, 1911: 305).

Steam engines were a definite fire hazard to fields, farm buildings, operators, and crops, according to Johnson in Farm Power in the Making of American (1978: 73). Sparks flew during the operation of the engines, often setting fires that required additional labor, time, and water to bring under control.

The significance of steam engines and tractors is that they constituted a transition in "power" on the farm

Fig. 1. Tractor Mishap

Source: Ellis and Rumely, 1911: 51.

from horse-to steam power engines-to gasoline traction engines (tractors). Despite their increase in power output, they were often handicapped by being restricted to large field operations. They were impractical for the small or hilly farm. Their cost was generally prohibitive for a single farmer to buy, so groups of farmers often bought or rented one together. "Threshing gangs" came out to a farm to do the threshing work at harvest time.

Steam traction engines were limited in other ways as well:

> Steam tractors never made good at pulling tillage apparatus because of their great weight and the difficulty in getting water to them on the dry Western plains where they could be used for breaking vast areas of virgin sod. The failure of the steam tractor for this purpose paved the way for the gas tractor (Currie, 1916: 13).

The development of steam engines for farming was based on James Watt's 1759 steam engine. Usually they were boilers mounted on an iron frame about 8 feet wide x 12 feet long. The axle on which the boiler rested was typically a roller 6 feet in diameter and 6 feet wide. They were often as big as a farm house and had either a horizontal or vertical tube boiler which burned coal, wood, or straw (Rasmussen, 1975: 3414). J.W. Fawkes adapted the first really workable steam engine as a steam "tractor" (or "steam-traction motor"). At first, steam engines were made as stationary equipment, but later were converted to portable units:

> The early steam engines furnished belt power, but they had to be pulled from place to place by horses or oxen. One of the first to be produced in the United States was the Forty-Niner. It was built in Philadelphia in 1849 by A.L. Archambault in 4-, 10-, and 30-horsepower sizes. The smallest of these weighed 2 tons, or a thousand pounds per horsepower (Rasmussen, 1975: 3414).

"Belt-or brake" horsepower is the amount of power generated at the belt pulley and which is the new energy available to do work (Jones, 1938: 355). The initial work done by the stationary steam engine was to replace the horse treadmill and horse-sweep which were used for threshing and baling hay.

The transition to portable steam engines made it possible to use non-human, non-animal power for plowing for the first time. Releasing humans from labor led to a reduction in the farm population needed to provide food for the nation. It also improved the living conditions for the farmer and eventually led to a greater farmer dependence on urban centers for marketing, financing, and purchasing farm implements and machines, as well as for other consumer goods (Rodefeld, et al, 1978: 62).

Boulton and Watt established the "horsepower" as the "measure by which the capacity of engines is rated . . at 33,000 pounds raised one foot high per minute" (*The American Cyclopaedia*, 1874: 830). The ability to "rate" power allowed comparisons between the ability of horses to do work and the ability of engines to substitute for that power. That is the horse-power rating (h.p.). The transition to power machinery began with the introduction of the steam traction engines which employed steam power to pull equipment, such as traditional plows which had been used behind horses. This proved inefficient because often the steam engines could not be steered without using horses to guide them. If one had to use horses to steer, one might just as well save himself the aggravation of learning how to use steam, and just stick with horses. The development of steering mechanisms (1880) and gearing systems (1870-1880) improved the ease with which farmers could operate the machines, but by that time the Otto four stroke internal combustion engine was being developed. Nicholas Otto's patent on his engine revolutionzied the entire concept of "power" even as steam engines were reaching their peak in sales (Rasmussen, 1975: 3414-3419).

Steam threshers had a decided advantage over using horse and man-power in threshing operations. Using a steam thresher, the work was compleed in less time, thereby saving many man-hours in labor. Greater acreages could be threshed in less time than could be done with horses. Steam engines pulled gang plows (see Glossary) and other implements and furnished belt power to drive shellers.

Farmers working together could thresh as much as nine hundred to one thousand bushels of wheat a day using steam traction engines, whereas one farmer using horses yielded only about fourteen bushels per day. (Now, with modern tractors and combines, a farmer can expect to harvest about 3200 bushels a day.) Though many farmers were skeptical of steam tractors, the best advertisement for their effectiveness was the empirical evidence of their role in the wheat country of the Midwest:

> The practice of steam plowing was rapidly extended. Vast tracts of level territory were opened where the acreage was so great as to discourage the idea of turning it with a single team and horse plows. Prairies were tamed in a twinkling . . . The path was then clear for the gas tractor. The farmers had been educated to traction farming (Ellis and Rumely, 1911: 223-224).

The operation of the steam engines must have been a sight on the prairies as the engine's smoke drifted over the fields. Many older farmers still recall the excitement of the entire family going out to the field to watch the threshing work progress as a new era dawned:

> The giant, smoke-belching steam traction machines with monstrous wheels and eerie whistles were especially adaptable to threshing and wood-cutting operation. They were gargantuan harbingers of a new mechanical era in which they were to play but a transitional role (Karolevitz, 1970: 93-94).

Watching the steam engines in operation, the farmer who had a sentimental attachment to his horses felt his "way-of-life" being threatened and some farmers vigorously resisted the notion of replacing horses with such monstrous machines. To these farmers, it was almost sacriligious to even think of replacing the horse:

> Horses were more than a source of power. Like people, they were flesh and blood and personality, and contributed uncertainty and excitement (Johnson, 1978: 11).

Without the horse, would the farmer need his large barn with ample hayloft for storing hay? Would he need the animals which had provided so much energy for work on the farm, if a machine would do the same work cheaper, faster, and with fewer laborers? After all, machines did not have personalities as horses did; horses could work, provide entertainment, transportation, and even friendship. To answer these questions, farmers began computing the actual costs of using horses. In desperation, some used every argument to dissuade the substitution of horses by machines; even "The exhaust of a mule or a horse is good for the land while the exhaust of the tractor is not" (Johnson, 1978: 12).

Such statements were made in all seriousness and indicated the deep-rooted good favor in which horses were held. Some farmers were simply reluctant to drop the long-standing cultural trait of using horses as a source of power on the farm. Their fondness for horses somewhat hindered the adoption of steam power on some farms that were capable of employing it. Indeed, some farmers were reluctant to apply mechanical power in any form, but they were in the minority. It is interesting to note that there was a definite time lag between the availability of knowledge concerning mechanization, and the actual general adoption of it in agriculture:

> It is a curious and suggestive fact that the application of machinery to agriculture lagged fully a century behind the application of machinery to industry (Morrison and Commager, 1955: 191).

The new power age bred its evangelizers of the beneficial uses of steam power on the farm, and the power debate continued. From 1850 to 1910, it was not a foregone conclusion that steam tractors would lead to the introduction of gas-tractors--and that the rural landscape would be extensively affected as a result. Too often we interpret history through the eyes of hindsight, forgetting that the changes and innovations that occurred were not automatically adopted. Individual farmers, given the choice of power on the farm, weighed the evidence and made thier choices:

> The decision to adopt a new practice can be broken down into a sequence of five stages:
> 1. Awareness
> 2. Interst
> 3. Evaluation
> 4. Trial
> 5. Adoption . . .
> (Summarized, from Slocum, 1962: 187).

Farmers were (and are) pragmatic; economic considerations have played an extensive role in sparking the willingness to adopt powerdriven machinery in agriculture:

> The economic use of machinery in agriculture is dependent on a number of factors . . . but there is one priciple common to all cases: a machine must do sufficient work to repay its capital outlay and working costs over a reasonable period (*Encyclopaedia Britannica*, 1942: 372).

Farmers became aware of steam tractors through plowing exhibitions and farm journal advertisements. Interest was developed because inventors knew farmers needed an easing of their workload; also, there was a ready market for their products. With the adoption of steam tractors, farmers could test for themselves the "old ways" versus the "new." In the case of steam traction engines, farmers found that they were too costly, dangerous, and cumbersome. They were also too narrowly restricted in their uses to make them economically attractive in the long-term. Steam tractors had serious disadvantages that caused occasional crises on the farm when they broke down, lost traction in wet soil, or--heaven forbid--blew up.

Though their greatest asset was their power to do more work in less time than was previously possible, farmers found that fuel to run steam tractors required a ready supply of cash on hand to buy coal. The tractors also required a skilled engineer for their safe operation. There were many additional problems associated with their use: they caused severe erosion due to compaction of the soil from their excessive weight; the steel lugs used on their wheels were to provide traction, but were quite ineffective in muddy soil, such as is common in the spring; the lugs dug into the soil, disturbing proper drainage; and the combination of the weight of steam tractors and the type of lugs used on the wheels caused erosion in areas that had experienced very little erosion before the advent of the steam tractors. Whereas steam threshers and tractors alleviated some problems in farming, they seriously exacerbated others. Figure 2 gives an indication of the likely affects that the wheels and lugs of steam tractors would have on roads and fields. Their affects on disturbing the soil are illustrated in Figure 3.

The low energy efficiency of steam tractors required hugh amounts of fuel and water to operate, but their chief deficiency was that they were an inadequte substitute for horses. Farmers even needed their horses in order to get the fuel and water to the tractors and threshers in the fields. As a result of the deficiencies in steam powered-tractors, horses remained the chief power source, and would be given up only reluctantly when the gasoline tractor came along:

> Displacing the ox, the horse and the mule was met with some resentment and a good deal of opposition. The age of steam as applied to farming (roughly defined as 1850 to 1900) had very little effect on the use of horses for both farming and transportation . . . the arrival of the gas tractor at the turn of the century brought the real confrontation between horse power and mechanical power. Even so, horses were dominant in farming the first quarter of the 1900s and did not really lose the battle to the internal combustion engine until the middle thirties (Johnson, 1978: 11).

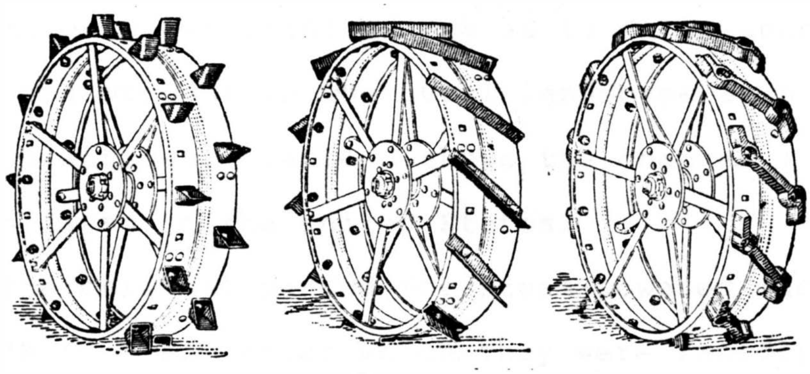


Fig. 2. Conventional-type Steel-rim Tractor Wheel Showing Common Types of Lugs

Source: Jones, <u>Farm Gas Engines and Tractors</u>, 1983: 333.

Fig. 3. Effects of Steel Lugs on Soil

Source: Jones, <u>Farm Gas Engines and Tractors</u>, 1983: 342.

An understanding of the "power revolution" in agriculture is essential if one is to fully understand of the changes wrought in the rural landscape as a result of farming practices. Table 3 shows the changes in power units on farms in the United States.

The critical period for steam-powered machines was from 1880 to 1910, after which they were rapidly displaced by fossil-fuel powered tractors. The rapidity of the power transition is astounding. In only fifty years (1850 to 1900) a great revolution occurred in farming as a result of the displacement of animal power by mechanical power. With the advent of the gas-tractor, the rural landscape soon was radically changed. Before 1910, however, there was actually little change in the landscape other than that the prairie lands were farmed sooner than they might otherwise have been. The giant steam machines proved the basic feasibility of using machines rather than horses. As a result, the number of animals on farms declined, as did the number of human laborers. Growth in the national population increased demand for agricultural products, thereby enhancing farmers' willingness to mechanize. The sheer amount of work that could be completed in a day, week or season

Table 3

CHANGES IN THE NUMBER OF POWER UNITS

FROM 1850 TO 1930

Years	Horses *	Steam Engines	Tractors
1850	4,337,000	-	- -
1860	6,249,000	-	- -
1870	7,145,000	-	- -
1880	10,357,000	24,000	- -
1890	15,266,000	40,000	- -
1900	15,506,000	70,000	- -
1910	17,430,000	72,000	10,000
1920	17,221,000	70,000	246,000
1930	12,889,000	25,000	920,000

* Animals two years and older; mules and oxen tabulated separately.

Source: Meig, J.L., ed., Mechanization in Agriculture, 1960: 7.

changed, and this had an affect on the extent of landscape-transformation by using steam machines.

The Landscape Before Gas Tractorization

The rural landscape centers around the "farm" insofar as we are concerned. "Farm" refers to land which is devoted to the raising of crops, livestock, and pasturage. Its hub is the "farmstead," which, for the geographer, is the base of all the operations on the farm:

> The farmstead is the center of operations on an American farm. It contains the operator's residence; barns and sheds for the shelter of animals, the storage of feeds and protection of tools and machinery; together with adjoining feeding pens and yards, a home garden, and possibly an orchard. Usually it varies in size from a fraction of an acre to a few acres in extent . . . It is at the farmstead that these raw materials from the fields are collected, processed, stored, or fed, and made ready for sale (Trewartha, 1948: 169).

The "farmstead" is where decisions are made, products for market are loaded onto wagons, livestock is housed in pens, barns or yards, and where all the elements come together to make "farming" a human economic cultural activity. The layout of a farmstead is a distinct cultural feature on the landscape:

> House types, production and communication facilities, domesticated plants, the ways in which open land and forest

> are allocated, all the features which constitute the visible cultural landscape, were once innovations that have arisen from their inconspicuous origins to become characteristic of their region (Hagerstrand, 1967: 1).

Barn types, field orientation, building types, lots, and pens are all indicative of the attitudes and values of the people who settled the land. The farmstead is a collection of the particular rural-cultural adaptations and innovations which occurred withing a given culture or location. With mechanization, the farmstead changed, reflecting changing needs:

> The entire homestead from its structural design to its various management programs is expressive of the homesteaders' view of life (Kern and Kern, 1977: 57).

The attitude toward the farmsteaed during the "horse era" was that the farm was "home" and "a way-of-life." With mechanization, there ensued a tendency to view the farmstead as a sort of agricultural production plant (as a modern factory is sometimes called "a plant"):

> In a physical sense a homestead is a complex organism for producing food. Raw materials are assembled, processed, stored, and converted here. This metabolic activity is complicated by factors of climate, space-time relationships, use of equipment, and constant growth and change, requiring an efficient layout. The engineered homestead is a system of organized centers that simplify and systematize work (Kern and Kern, 1977: 64).

Just as farmers' attitudes toward replacing horses with machines to do work influenced their fashioning of the cultural landscape, so too did their "world-view" influence the particular elements of the farmstead on a micro scale, e.g., in their houses, barns, and other buildings. In cultural geography, it is difficult to separate aspects of a study which involve settlement geography, history, and sociology; therefore, we must look at the material culture traits in order to gain insight to changes in the rural landscape:

> To a geographer, farmsteads are one element of a region's settlement fabric. Not only their spacing and distribution as units . . . but also their areas, dimensions, locations, number of buildings, and the sizes, functions, and arrangement of their buildings and yards are essential ingredients of a region's settlement geography (Trewartha, 1948: 170).

Geographers increasingly are turning their attention to the elements of the farm, which include: fences, silos, granaries, bins, windmills, sheds, lots, farm orientation, farm layout, lots, yards, and driveways. The central focus remains the "farmstead" since it constitutes a clear pattern in which all the elements co-exist in a network of inter-related culture traits.

On most farmsteads during the pre-gasoline tractor period, the house was the hub around which the other buildings, lots, yards, and pens were built. The house

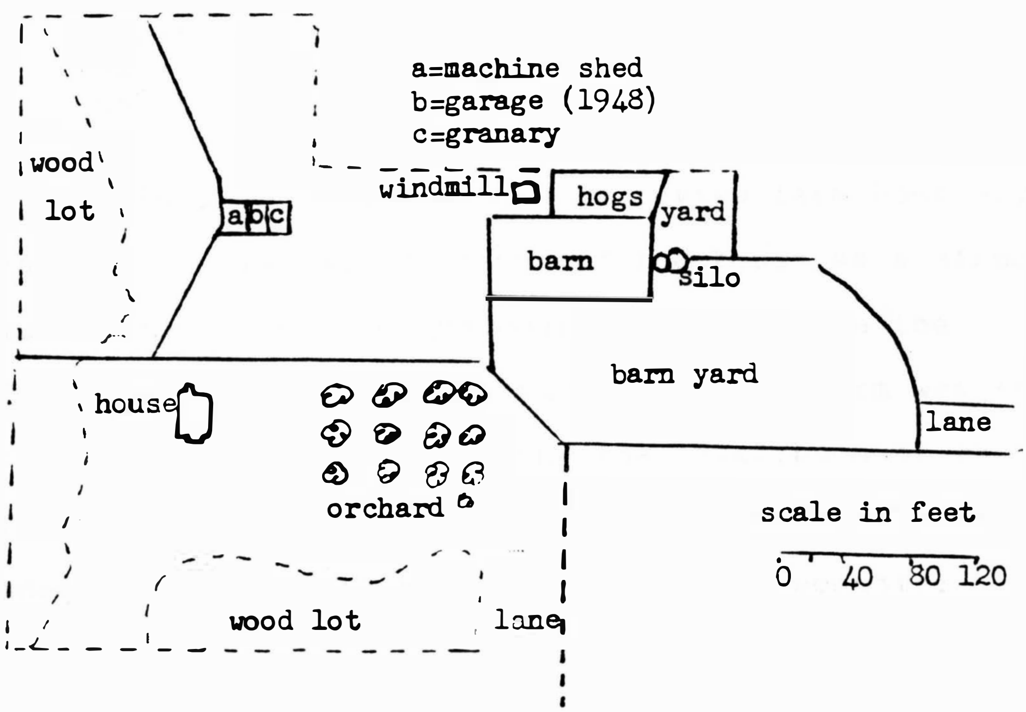


Fig. 4. Representative Midwestern Farmstead

Source: Trewartha, Glenn T., Some Regional Characteristics of American Farmsteads, 1948: 69.

was chiefly utilitarian with an emphasis on comfort and economy, though there were efforts to beautify some farmsteads with ingenuous and stately house designs. For the most part, the typical farm house was uninspired and practical:

> . . . in some arrangements of farm buildings one would almost think that the house was put in as an afterthought and allowed a position among the other buildings only as a favor and by sufferance (Benson, 1917: 648).

This study can not hope to review farm house-types; rather, the secondary status of the house as a structure may be contrasted to its central location on the farmstead. The primary structure on the farm was the barn. Without a proper barn, the livelihood of the family could not be assured. Midwestern winters required adequate shelter in a livestock-raising economy:

> Imposing barns and silos are the dominant features of farmsteads in the dairy farming areas of the Middle West . . . The massive dairy barns have large lofts for hay storage and sturdy masonry ground floors with numerous windows to admit light and air (Hart, 1972: 270).

The old dairy barn was an imposing cultural feature in the dairying regions of the Midwest. On most farms, the barn dominated the farmstead; it was the largest building and required more careful planning than the house or other buildings:

> When the farmer builds his house he draws a rough sketch for the architect, but when he builds his barn you will find him sitting up nights planning and expressing himself in design. He knows the welfare of his family depends upon the comfort of his cattle. No matter how things change on the farm, the biggest and most expensive thing there will always be the barn (Sloane, 1954: 78).

This statement was undoubtably true when horses were the dominant power souce on the farm. When tractors displaced horses, barn use and barn structures changed. The farmer no longer needed the huge horse barn with hayloft. He could get by with a smaller structure which housed his machinery; it also did not require heating or windows to admit light, hence was easier to build and maintain.

Barns were usually oriented in a recommended manner, with their "backs to the wind":

> Most Midwest barns are placed with their sides facing the cardinal points . . . Prevailing winds always ruled the position of buildings. Some people might insist that old barns and farmhouses were placed according to the direction of the highway without realizing that what is now a roadway was then probably only a cowpath (Sloane, 1954: 58).

This was a common-sense arrangement which not only protected the livestock from the harsh winter winds, but also provided an artificial windbreak for the house.

The location of the farm house on the farm (as distinguished from the "farmstead") was generally made on the whim of the settler, though there were certain considerations of importance: the location near a water souce, good drainage, availability of wood, and preferably, a central location in the farm. If a farmer owned 160 acres, his farm house and buildings were located as near to the center of the farm as possible, barring adverse landscape conditions, or a more preferable siting elsewhere, due to other factors. Farmsteads generally were rectangular shaped, with the house and buildings forming the center:

> Corncribs, granaries, smokehouses, and sheds of various kinds were fitted into the pattern around the house and the barn . . . Often a real effort was made to beautify the farm by spacing stately elms or evergreens along the drive leading to the yard and by arranging flowerbeds and shrubbery in attractive designs around the house (Jarchow, 1949: 99).

The types of buildings found on the farmstead depend upon the type of farm; whether dairy, grain, livestock, or mixed general farming. The barn is of primary importance on the farmstead. (For a typology of barns, see Figure 5).

A typical dairy farm would have the big Wisconsin or Midwestern dairy barns, for example:

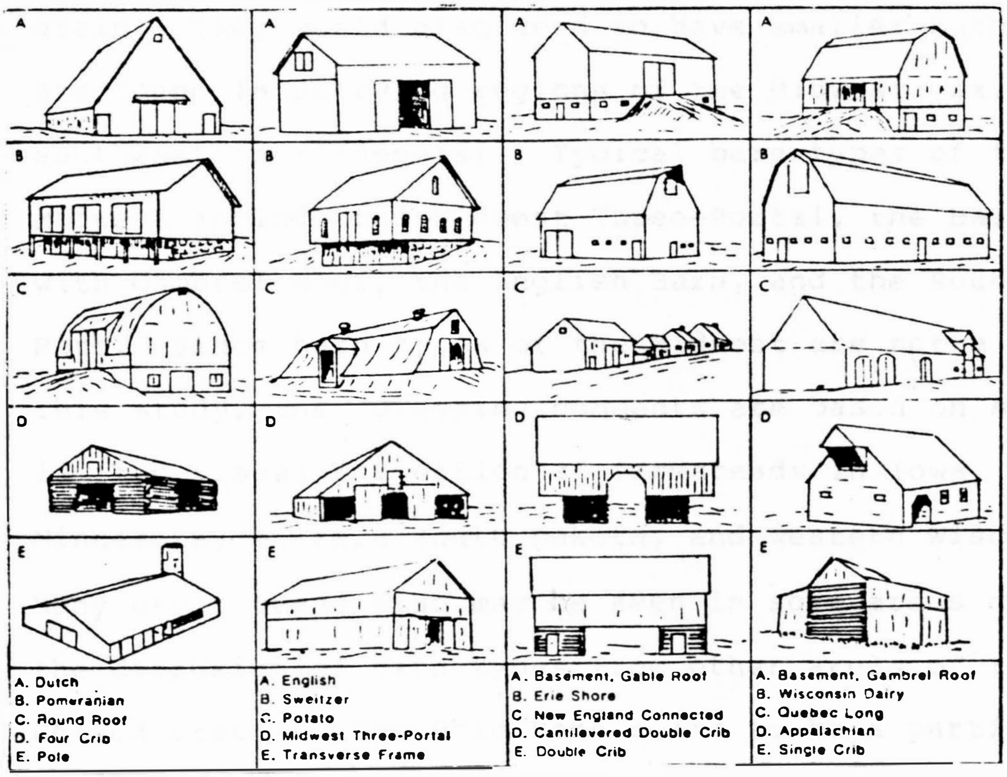


Fig. 5. Barn Types

Source: Noble and Seymour, 1982: 156.

> The distribution of this barn type is associated with areas where dairying is the most effective and prosperous kind of agriculture (Noble and Seymour, 1982: 161).

Farms which grew a lot of corn or wheat would be more likely to have several bins, silos, or cribs for storing grain. They would also tend to have smaller barns than are found in dairying regions of the Midwest (ex., southeastern Minnesota). Typical barn types of the Midwest include the Midwest Three-Portal, the Basement with Gambrel Roof, the English Barn, and the Round Roof Barn. Since barn types of the Midwest are not a focus of this study, the foregoing comments are based on somewhat limited visual inspection of farmsteads in Iowa, Minnesota, eastern South Dakota, and western Wisconsin. Many other types also may be seen in some areas due to the diffusion of barn types from other areas of the United States. The Pole Barn seems to be a particularly Midwestern barn type, as is the Wisconsin Dairy Barn (Noble and Seymour, 1982).

Before the advent of the mechanical era in farming, barns were built to house animals, and to store their feed and needed equipment. When steam engine tractors became popular, barns began their metamorphosis into "machine sheds." Concomitant with the change in building usage was the need for new skills on the farm. The farmers had always been do-it-yourself mechanics, blacksmiths, and trouble-shooters. With the steam traction engines, and later gas-tractors, farms needed a tool shed and machine shelter, rather than a blacksmith shop. The farmer had to be his own mechanic since the steam tractors and threshers were so new, few people were trained in their care and repair. As a result of the changing needs on the farm, farm buildings changed. The old blacksmith shop was converted into the early proto-type of the garage. On the farmstead, the barn lost its importance as a shelter for animals, as it became a storage unit for machinery and hay (for cattle). The farm began to enter the Industrial Age as more and more machinery appeared in the fields, the farmstead courtyard, and in the farm buildings. All of these and other cultural traits were affected by the transition from using horses on the farm, to using steam tractors.

Man's imprint upon the landscape was most evident in the extension of the wheat-growing lands westward:

> The invention of better plows, grain drills, and harvestors came coincident with the westward expansion of the wheat belt and lowered the cost of harvesting to a new low level which continues for several decades until the combined harvester-thresher appeared (Collier and Son, 1960: 320).

The expansion of the wheat belt westward was largely made possible by the steam thresher and steam tractor. By lowering the costs of threshing and other farm operations, steam powered engines made farms less subsistent in nature. As they became more commercial, farmers became linked to nearby urban centers.

> The farmers bought the cast iron and steel plows, the cultivators, and other farm machinery because the equipment helped them to increase the returns from their labor (Bogue, Phillips, and Wright, 1970: 423).

The geographical impact of changes in rural cultural traits, such as changing the power source for farm work, was both local (on the farm) and regional (in the Midwest, for example). Micro changes on the farmstead are inevitably linked to macro changes in the rural landscape as a whole, and to the growth and changes in the urban landscape in part. In Minnesota, the introduction of farm machinery and steam power led to great changes in the agricultural industry, especially in farming the prairie:

> The steam thresher made its appearance in Minnesota not later than 1867. In that year, Sylvanus Jenkins raised wheat on more than four hundred of the 1,036 acres of his Dakota County farm. This was then the largest farm in one tract in the state, and naturally many machines were to be found on it (Jarchow, 1949: 144).

Mr. Jenkins very likely could not have farmed that much acreage of wheat without the steam threshers and tractors. In fact, steam powered machines made the growth of the wheat belt possible in the Midwest. The Red River Valley area was particularly affected by the use of steam threshers, as Drache somewhat facetiously reports:

> It is said of the Wheeler farm near Stephen, Minnesota, that "if a man started a furrow, his grandson would have to finish it." The farms [in the Red River Valley] were large, and commonly each section of land was treated as a single field. It was an ideal place to experiment with new larger machinery that the farmers had to use and demanded from machinery manufacturers (Drache, 1976: 7).

Not many farms were the size of Jenkins and most fields were considerably smaller than 640 acres; typically, they were in the range of 10 to 80 acres. Farmers worked where they could, using the power source at hand, but the steam tractors made a definite impression on many farmers:

> At its peak around 1910, approximately 72,000 steam tractors were used on U.S. farms (Sargen, 1979: 2).

Despite their drawbacks it is easy to comprehend the popularity that the steam tractors and threshers enjoyed:

> In 1840, 233 man-hours were required to produce 100 bushels of wheat; in 1900, 108 . . . Corn required 276 man-hours in 1840; 147 in 1900 . . . (Collier, 1960: 324).

Man-hours saved meant money earned on the farm. The ability to make the transition from subsistence to commercial farming partially resulted from the mechanization of farm work. As a result of the greater prosperity of the rural population, Midwestern urban centers grew, especially those which served as manufacturing centers for the major tractor firms. St. Paul, Minneapolis, Moline, Des Moines, and Chicago were major outlets for farm implements:

> Many farmers started buying self-propelled steam engines in the late 1870s. About 3 thousand steam tractors and almost that many steam threshers were built in 1890 . . . By 1910 more than 30 firms were manufacturing 5 thousand large steam traction engines a year (Rasmussen, 1975: 3417).

The growth of these manufacturing centers was the result of several factors, including proximity to areas which required greater application of self-propelled steam engines for their power. Iowa, Minnesota, North and South Dakota, and Illinois are examples:

> Far and away the greatest impact of the Steam Age upon American agriculture

> came of the heaped up industrialization in great centers and the centering there of financial power and might (Lord, 1962: 215).

Though others might disagree with Lord's assessment, the impact of the so-called 'steam age' cannot be denied. It:

1. Increased agricultural activity on the land, i.e., the opening of the prairies

2. Increased worker productivity per man-hour; with fewer workers needed, outmigration from rural areas to urban occurred

3. Hastened the transition from an agrarian to an industrial age on the farm

4. Increased returns for farmers' labor, i.e., stimulated greater income

5. Brought about farm improvements due to its ability to remove debris and stumps, clear shrubbery, and perform other maintenance tasks

6. Created a demand for improved farm machinery and implements, better yielding seeds, and improvements in conservation practices

7. Hastened the westward expansion of the wheat belt

8. Increased national exports, by providing cheap surpluses

9. Set the stage for the advent of the gas-tractor's adoption

These trends, set into motion by the application of steam power on the farm, are still affecting the rural landscape today. Geographically, the importance of the steam engine may be reduced to two basic statements:

1. Steam engines made possible the rapid settlement and successful farming of the Midwestern prairie much quicker than would have been possible using horses (as well as mules and oxen), to generate power. This started the displacement of horses by machinery.

2. The greatest affect of steam powered machinery on the farm was that of educating farmers to the advantages of using power machinery. This in turn led to the quick adoption and diffusion of gasoline powered tractors, once farmers knew that basic problems had been solved in their construction.

The steam engine preceded the gas engine and paved the way for its success; of the two, the gas tractor had the greatest impact upon the rural landscape. Its role is discussed in the following chapter.

CHAPTER III

THE ADVENT OF THE GAS TRACTOR

Historical Background

In 1877 German inventor Nikolaus Otto patented his four stroke cycle internal combustion engine, which revolutionized the "tractor" industry and farm power. In 1889 "Otto" engines were placed on the same chassis used on steam traction engines (Karolevitz, 1970: 97). From 1877 to 1919 intensive experimentation occurred with fossil-fuel powered engines used for threshing and plowing. The early gas-traction engines had the same types of problems as steam engines:

> They were heavy monsters weighing twenty to fifty thousand pounds, seriously damaging to the soil and involving an enormous capital investment (Meig, 1960: 6).

There were many manufacturers involved in designing gas-traction engines, including: the Charter Gas Engine Company (1890), the Case Threshing Machine Company (1892), John Frowlich's Waterloo Boy (later the John Deere Company (1892), Nickolaus Otto (1894-1896), Charles W. Hart and Charles H. Parr Company (1901), and Henry Ford (1919) with his "Fordson" (Karolevitz, 1970: 97-98). There were hundreds of other companies, but these were some of the primary manufacturers whose machines evolved into the "tractor" with which we are familiar.

The naming of the "tractor is an interesting subject. One version of its origin is that it is a combination of "traction" and "motor," that is tract-or, as coined by Gideon Morgen in 1850 (Schapsmeier,1975: 349). A second version of the machine is that it was coined by W. H. Williams:

> In the summer of 1905, I joined the Hart-Parr Campany as a sales manager . . . But these machines were not then known by that name 'tractor.` They were called gasoline traction engines. In 1907 I began using the work 'tractor' in our advertising ("The Gas Engine Magazine," March-April, 1978: 3).

Whatever its origin, certainly the term caught on, as well as did the concept. The early gas-tractors were of every imaginable shape, some of which were quite ludicrious. See Figures 6 and 7 for examples of early gas tractors, ca. 1890s.

Often manufacturers produced machines that were never field-tested; farmers soon found out that not every tractor was equal to its advertised claims. For the most part, however, tractors were readily accepted and worked fairly well:

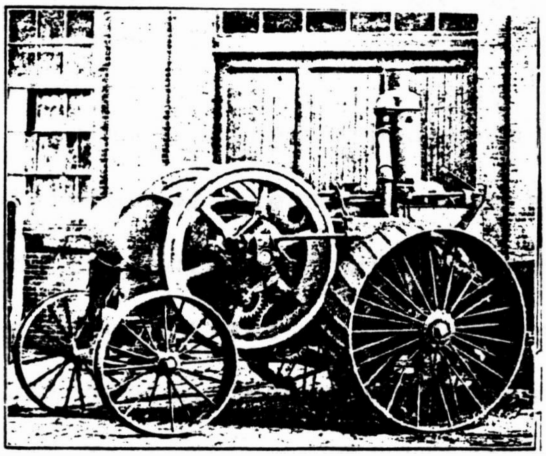


Fig. 6. Early Gas Tractor - 1892

Source: Jones, 1938: 20.

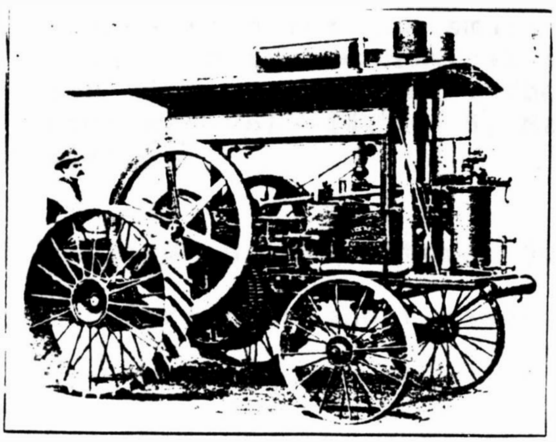


Fig. 7. Early Gas Tractor - 1897

Source: Jones, 1938: 20.

> Something of the satisfactory service obtained from the thousands of tractors now in use is revealed when it is brought to light that there is no second-hand tractor market ("The Gas Engine," Vol. 18. No. 4., Ap. 1916: 190).

Farmers already had seen some of the dramatic capabilities of steam traction engines compared to farming the "old way" with horses. The debate over horses or gas-tractors overshadowed the controversy concerning steam power on the farm. The basic question for many farmers was whether they needed a gas-tractor. For many farmers, the decision was cut and dried, based on economy:

> If the tractor proves the more economical, the horse must go. If the tractor proves to be too big a proposition for the small farm, a change in the economical size of the farms may result ("The Gas Engine," Vol. 14, No 5, May 1911: 252).

Writers in agricultural journals responded to the need for information about gasoline (and kerosene) powered tractors and supplied an impressive array of articles devoted to the subject. By 1910 gas tractors were a familiar topic, as comparisons were made between horses and tractors:

> The most recent evidence of the superiority of the gasoline engine is the superb cut made by the John

> Crow combine drawn by a gasoline traction engine. In one day a total of 65 acres of wheat land was cut, threshed, and sacked, which is perhaps the most remarkable harvest performance ever recorded in this section. When it is remembered that 25 acres is considered a big cut for an ordinary mule or horse outfit in one day, it would seem that the new machine has a pretty good change to become popular ("The Gas Engine," Vol. 12, No. 9, Sept. 1910: 480).

In hindsight, such a statement seems naive, but it was considered "progessive" at the time. By 1910, steam tractors were definitely on their way out as gas tractors established a firm place on thousands of farmsteads. Contests between the two forms of power were held in Winnipeg, Canada, during that year:

> It has been said that the Winnipeg plowing matches of 1910 started a decisive trend against steam. On that occasion fields were soaked by heavy rains. The massive steam engines quickly mired down and gas tractors were used to pull them out. This occurred in spite of the fact that the first gas tractors were themselves bedeviled by too much weight per horse-power (Johnson, 1978: 73).

Gas tractors sold quickly following the reports of the contest results in newspapers and agricultural journals. By 1911, steam tractors were outsold by gas-tractors, and by 1930 steam engine sales were back to their 1880 levels, when they were first successfully marketed (Meig, 1960: 7).

Early on, farmers needed specific information of the capability of the gas-tractor on the farm. The Hatch Act (1887) established Agricultural Experiment Stations which later funded "power studies" to determine the capability of gas tractors--as well as their cost-effectiveness (Meine, 1950: 374):

> The basic approach that was used to determine the superiority of tractors or horses as sources of farm power was empirical in nature. A sample of farms for a particular region or locale was selected to obtain budget information that would enable the cost of power on farms with horses to be compared with that on tractor farms (Sargen, 1979: 85).

Early tractors ranged from 400 to 32,000 pounds and cost anywhere for $150 to $5,400 ("The Gas Engine," June, 1917: 278). Gas tractors proved to be economical due to lower fuel costs compared to the cost of feeding horses. Gasoline (and kerosene) cost about 10 cents per gallon in 1910, which even then was ridiculously low (Johnson, 1978).

Because horses had never been compared to mechanical power, tests were needed to determine the exact value of their power. The Winnipeg contests field tested steam and gas-tractors' performances in hauling and plowing matches:

> The first Winnipeg trials were mainly contests . . . for comparison of such factors as the thousand foot-pounds hauled per pint of fuel and the pints of fuel per acre. The trials became more comprehensive with the years, until in 1912 the score sheet included an economy brake test, maximum brake test, plowing test, and a rating on design and construction . . . The interest created by the trials encouraged experimenters and manufacturers to continue their pioneer efforts (Rasmussen, 1975: 3421).

Following the Winnipeg tests, states initiated their own legal standards for tractors, beginning with the 1919 Nebraska Tractor Law:

> The Nebraska Tractor Law specifices: '. . . Each and every tractor presented for testing, shall be a stock model and shall not be equipped with any special appliance or apparatus not regularly supplied to the trade . . . Such tests shall consist of endurance, official rating of horsepower for continuous load, and consumption of fuel per hour or per ace of farm operation (Ibid: 3424).

Such laws were practical only after Henry Ford began standardizing tractors in his mass-production of the "Fordson." Other manufacturers soon followed suit. Nationwide, farmers came to rely on the power rating attained by actual field tests, rather than on advertisers overly-optimistic claims.

In the Midwest, farmers were quick to adopt gas tractors. After comparing horses, steam power, and gasoline engine power, these farmers were convinced that their labor would be most effective using the gas tractor:

> The most common situation in the Great Plains, thus, was one in which the farmers and farm labor . . . performed the pre-harvest operations either with a team of horses or with a tractor--which the farmer owned rather than rented. Given this situation, the relevant decision for the farmer was not one of the optimal use of tractors and horses in performing various farm tasks, but rather that of selecting the optimal process to meet a demand for a specified output level (Sargen, 1979: 76).

The demand for higher farm productivity was satisfied; at the same time, the ideology of the family-sized farm was preserved:

> Dreamers argue that the ideal farm is the little farm well-tilled, because of the independent home life which it brings. The gas engine will come nearer solving the problem of mechanical power on this ideal farm than steam (Ellis and Rumely, 1911: 237).

The affect of tractorization on the family-farm will be discussed later in this study. The choices of power for farm-work were often confusing before there was a method of actually testing the forms available. In 1911, L.W. Ellis and Edward A. Rumely ranked horses, steam engine tractors, and gas-tractors in performing farm tasks. See Table 4.

The results of the comparisons showed that the gas tractor ranked first 18 times in contrast to steam or horse farming. The impact of empirical testing on gas-tractor sales led to a boom in the farming implement business as more machinery was adapted for use with tractors:

> The tractor permitted the mechanization of many other farm operations. Tomato production and hay making are examples . . . the agricultural revolution was not the result of adapting some one tool or technology. Rather, it came through farmers adopting what has been called a 'package' of agricultural technology (Rasmussen, 1975: 2919).

The gas tractor made it possible for farmers to clear wooded areas, to work more land than was previously possible, and to do various other tasks requiring a high energy input. Just as horses were valued as the chief "power" on farms, tractors rapidly attained the prominent position as farm power source. For a more complete discussion of the history of farm mechanization and tractorization, see Sargen's Tractorization (1979), and Karolevitz's Old-Time Agriculture in the Ads (1970).

In general, there have been five stages to the gas-tractorization of farms:

Table 4

RANKING POWER SOURCES IN FARM WORK

Essential Phases of Adaptability	Farm Horse	Steam Tractor	Gas Tractor
Flexibility in power	1	2	3
Reliability	1	2	3
Range of usefulness	1	3	2
Necessity for adjustment	1	2	2
Ease of repair	3	1	1
Endurance in hours of work per day	3	1	1
Period of work without renewing supplies	2	3	1
Concentration of power in ground area	3	1	2
Investment in power per acre tilled	3	1	1
Investment in plows per acre tilled	1	2	3
Storage space per tractive h.p. of motor	3	1	2
Storage space for fuel per tractive hp. hr.	3	2	1
Quality of shelter required	3	1	1
Cost of maintenance in idleness	3	1	1
Cost of operation in small units	1	3	2
Cost of operation in medium to large units	2	2	1
Cost of operation in very large units	3	1	1
Skill required in operation	1	3	2

Table 4 Continued

Essential Phases of Adaptability	Farm Horse	Steam Tractor	Gas Tractor
Amount of labor in operation	3	2	1
Frequency of attention in idleness	3	1	1
Weight of fuel per unit of work	3	2	1
Weight of water per unit of work	2	3	1
Variety of fuels utilized	2	1	3
Distribution of common fuels	1	2	3
Convenience in handling of fuel	3	2	1
Cost of energy in fuels	3	1	2
Thermal efficiency in stationary work	3	2	1
Thermal efficiency in plowing	2	3	1
Tractive power in relation to weight	3	2	1
Tractive power in relation to stationary power	1	3	2
Stationary power in relation to weight	3	1	2
Mechanical efficiency	-	1	2
Pressure exerted upon soil	1	3	2
Promise of future improvement	3	2	1

Source: Ellis & Rumely, 1911: 296.

1. World War I-1927 . . . when the value of farm machinery reached a peak that was not attained again for twenty years.

2. 1928-1937 . . . marked by the decline in both production and value of equipment . . . until 1937, when farm production began to recover and farmers were again able to buy new machinery.

3. 1938-1945 . . . marked by a more rapid increase in mechanization than every before (items 1 through 3, Collier, 1960: 322).

4. 1946-1965 . . . marked by an increase in "horsepower" units of nearly 61 million horsepower (Rodefeld, et al, 1978: 46).

5. 1966-present . . . marked by a revolution in increased size and horsepower rating per tractor, with power takeoff, and other innovations.

These stages are a general guide to the evolution of the gas tractor. In the following chapter, the impact of gasoline powered tractors on the rural landscape will be considered.

CHAPTER IV

GAS TRACTORS AND THE RURAL LANDSCAPE

Changes in Land Use

The essential question posed by this study is "how did the adoption of gas-tractors affect the rural landscape?" We are already familiar with the role that steam power played in the farming of the Midwestern prairies. Gas tractors were even more dramatically involved in the taming of the prairie:

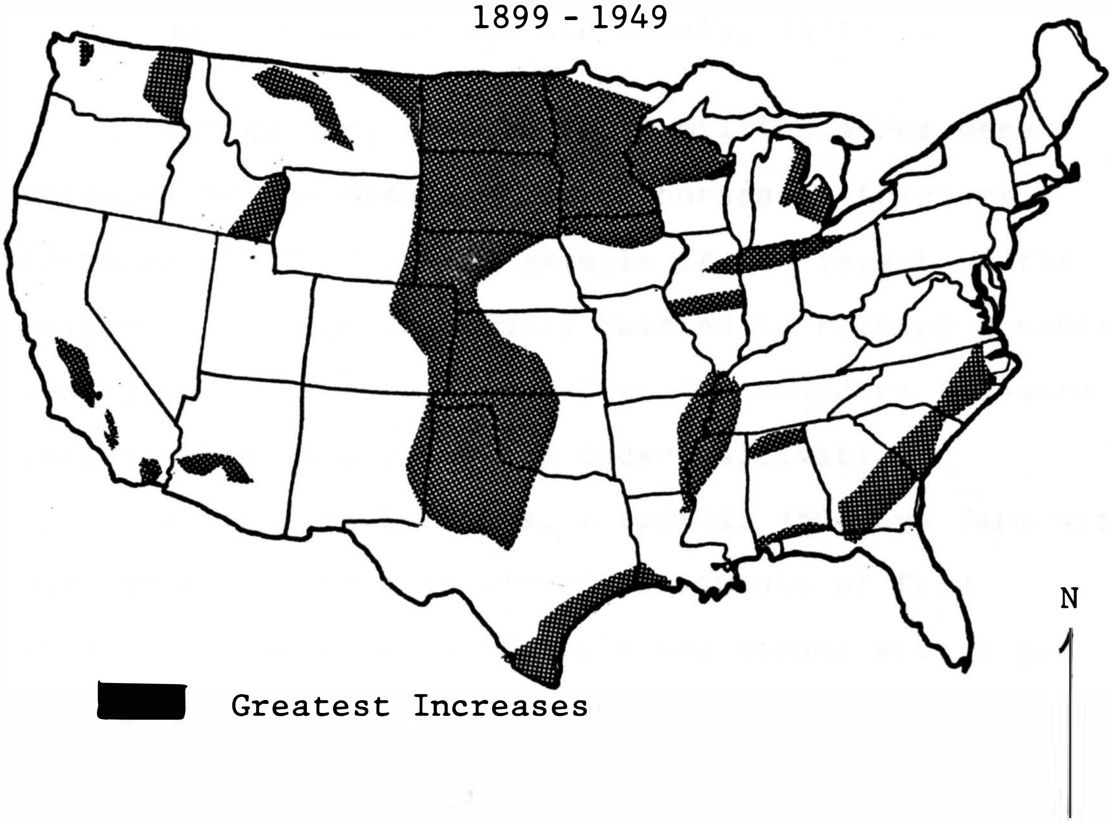
> The increase in crop acreage harvested in 1924 as compared with 1919, occurred mostly on the level prairie portions of the United States, where, despite the subhumid climate and low prices for farm products, the use of modern machinery, by increasing the area a man can cultivate, has made crop production profitable (Baker, 1928: 365).

Map 1 shows those areas within the United States where the greatest increases in tilled farmland occurred; the shaded areas also are where the greatest impact of tractorization was felt.

The increases in acreage a farmer could cultivate are more meaningful when one remembers that for every horse released from farm work, five acres were gained for cultivation of cash crops:

Map 1

INCREASE IN HARVESTED CROPLAND ACRES
1899 - 1949



> Every horse displaced by mechanical power adds five to eight acres to the area devoted to human maintenance. Back of the motor contest, then and giving it force, is the call for the taming of the prairie, and, deeper than that, the cry of the increasing millions for an abundance of their daily bread (Ellis and Rumely, 1911: 11).

Altogether, some 60 to 70 million acres were released by the displacement of horses by tractors (Johnson, 1978: 12). An example of the impact of the release of acrage proviously devoted to raising horsefeed can by seen in Table 5, based on the standard 160-acre farm of which 100 acres are under cultivation:

As this table shows, a typical 160-acre farm with six horses required an incredible amount of feed annually. The affects of replacing horses with a gas tractor include a change in crops grown, such as hay and oats being replaced with such cash-crops as wheat, corn, or soybeans. (Some hay continues to be grown for cattle feed).

Figure 8 shows an idealized quarter-section farm with the typical 100 acres devoted to crops. The remaining 60 acres presumably would remain uncultivated due to unsuitable soil, terrain, wooded areas, creeks, ponds, and roads. In this representation, "D" constitutes the 30 acres reserved for growing horsefeed. (These idealized representations of a farm are not meant

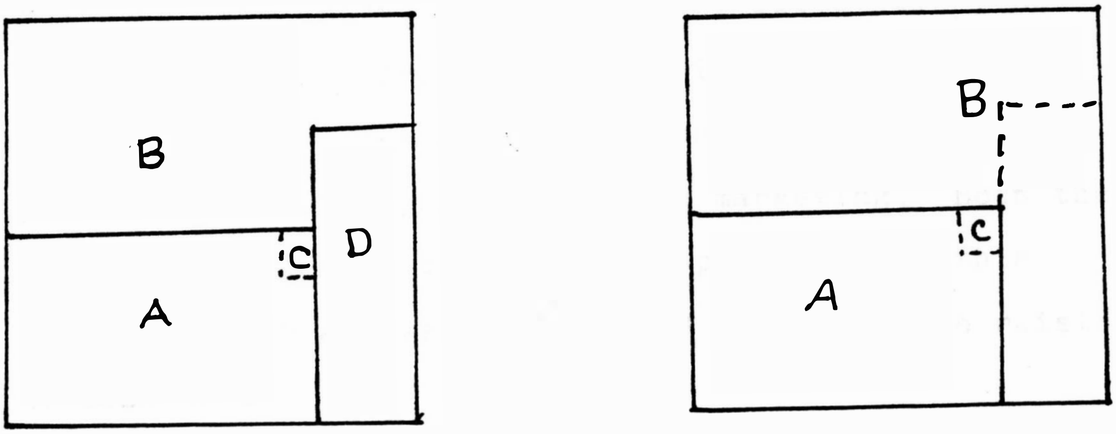
Table 5

FEED REQUIRED ON A FARM WITH SIX HORSES

Feed	One Horse	Six Horses
Oats	5,750# per year	34,500# per year
or		
Corn	4,745# per year	28,470# per year
and		
Hay	4,390# per year	26,180# per year

Adapted from: Collier & Sons, 1960: 524.

(1) (2)



A=60 acres, uncultivated
B=70 acres, cultivated
C=the farmstead
D=30 acres, for horsefeed

(1) WITH HORSES

A= 60 acres, uncultivated
B=100 acres, cultivated
C=the farmstead

(2) WITH TRACTORS

Fig. 8. Idealized Quarter-Section Farm
Adapted from: Collier, 1960: 524.

to suggest that fields were the size of the divisions shown).

Farm (1) which used 6 horses on its 160 acres, typically grew oats, hay, and corn as its principle crops in the 30 acres devoted to "horsefeed" in section "D". Farm (2) substituted the gas-tractor for its horses, thereby releasing the 30 acres for cash-crop production. One result of the increased production of cash-crops was that the farm needed more granaries, silos, bins, and other storage and processing facilities. The local market town also needed an elevator for storing and processing surplus grains awaiting marketing. Both the farmers--and nearby market towns--prospered as this "released" acreage was transferred in use to the raising of cash crops.

Producing feed for farm draft animals constituted a considerable usage of acreage. Figure 9 shows the total acreage used for raising feed for horses and mules and the amount of land released due to decreased dependence on animals as a power source.

The expansion of the agricultural domain began with steam power and accelerated with the advent of the gas tractor. The all-purpose tractor initiated a new revolution in agriculture--the "power revolution." That revolution in the ability to farm increased acreage

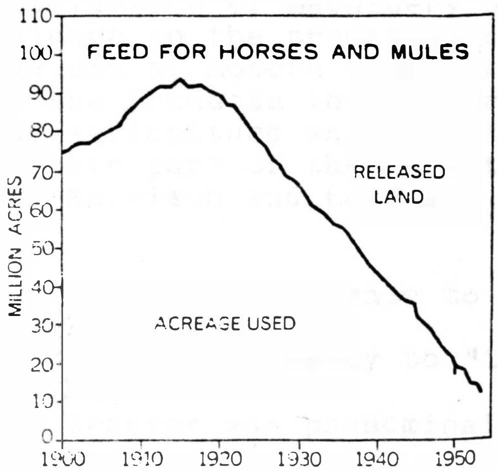


Fig. 9. Acreage Used For Feeding Horses and Mules

Source: Harris, 1957: 180.

involves such other factors as increased use of fertilizers, the building of better rural roads, and the availability of other mechanized machinery such as the combine:

> . . . agriculture itself was undergoing a revolution brought about through the operation of three basic factors: the expansion of the agricultural domain, the application of machinery and biological science to the processes of farming, and the use of modern transportation to convey the products to world markets. . . it made agriculture an intimate though subordinate part of the industraial system (Morrison and Commager, 1955: 189).

The shift from subsistence to commercial farming was concomitant with a tendency to "industrialize" the farm. The gas tractor was phenominally successful and led the transition from horse-farm to "factory-farm" in many instances.

It was not until 1915 that horses were truly supplanted by tractors on American farms. By that year, the number of horses decreased to a level from which they never again were to regain their former levels (Collier, 1960: 322). By 1914, World War I had placed increased demands on American agriculture, making the tractor a necessity on the farm:

> Then, in 1914, came World War I. The war wasn't fought on our land. But in Europe, not counting Russia, fifty million acres of farm land were useless after the war. No one could grow

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> Then, in 1914, came World War I. The war wasn't fought on our land. But in Europe, not counting Russia, fifty million acres of farm land were useless after the war. No one could grow

> wheat or anything else on this land until it was cleaned up and in good condition again. People would have starved by thousands if they had not had our wheat. . . Growing this wheat meant digging up more of the Great Plains, plowing up grassy hills, trying to farm areas that had always been pretty dry. . . This was in the 1920's. And it was after that, in the 1930's that the bad dust storms started (Helfman, 1961: 99-100).

The tractorization of American farms set into motion a series of changes in the landscape that are still being felt today. The social and historical forces at work in the early years of gas-tractorization had direct and indirect impacts upon man's modifications of the rural landscape. One of the social impacts was the displacement of farm workers due to tractorization. The shortage of farm laborers during World Was I also gave impetus to the trend to mechanize the farm:

> Two million men will be gone from the farms because of the war--strong, skilled, willing workers, only a small part of whom can be replaced by older men, boys, and women. Yet production of food must be increased. There is only one way--equip the men left on the farms so they can do more work than ever before. [An ad by the Moline Plow Company, Moline, Illinios, during World War I.] (Johnson, 1978: 87).

As men went to war, tractors were more readily adopted to fill the vacuum left in farm labor. Agricultural journals were filled with ads advancing the merits of the tractor on the farm:

> With the help of a Case Kerosene Tractor, it is possible for one man to do more work, in a given time, than a good man and an industrious boy, together, working with horse. By investing in a Case Tractor and Grant Contour Plow and Harrow outfit now, your boy can get his schooling without interruption, and the Spring work will not suffer by his absence . . . Keep the boy in school--and let a Case Kerosene Tractor take his place in the field. You'll never regret either investment [ca. 1918] (Johnson, 1978: 97).

What the ad does not say is that after the War, when farmers returned to their homes, they found that the tractor was more efficient at replacing human labor than they had ever imagined. A combination of economic factors, over-production of grains after World War I, droughts, and increased efficiency in agriculture, led to the "tractoring off the farm" of millions of people by the 1940s:

> Every tractor purchased helped to decrease the farm labor force, which dropped from 13.5 million in 1910 to 4.2 million in 1973. At the same time, the average farm size increased from 138 to 385 acres (Drache, 1976: 407).

By decreasing farm labor, many social readjustments resulted, including migrations from rural areas and resettlement in large urban centers. Tractorization was a great force not only in directly modifying the rural landscape, but also in indirectly affecting the ways in which people made a living, used the land, and arranged their patterns of settlement. The economic viability of the family farm gradually was threatened by the demands to produce cheap food, chiefly made possible through intense mechanization of farm operations.

The economic inputs to achieve the mechanization responsible for these changes centered around increasing investments in farm tractors. At the same time, the worker output per man-hour increased:

> To highlight the mechanical aspect of the technological revolution in agriculture, in 1935 each farm worker had from two- to three-tractor horsepower available to him, while today, 1978 when this article was written, each worker has in excess of 40-tractor horsepower at his service, and altogether U.S. farmers have tractors harnessing 212 million horsepower (Ford, 1978: 76).

The increase in worker output was directly related to the number of tractors on a farm. Table 6 shows the numbers of tractors in the West North Central region of the United States, which includes Minnesota, Iowa, Missouri, South Dakota, North Dakota, Nebraska, and Kansas.

The West North Central states, where the greatest amount of tractorization took place, also exhibit the greatest impact upon the landscape due to tractorization.

Table 6

TRACTORS ON FARMS FROM 1920 - 1959
IN THE WEST NORTH CENTRAL STATES

1920	92,123
1925	151,838
1930	295,160
1940	487,942
1945	631,151
1950	705,670
1954	753,682
1959	698,519

Source: Sargen, 1979: 53.

Not only did tractorization displace horses and man-power on farms, it also changed the primary activities of the bulk of the human population:

> What achievement of our mechanical and industrial age is more distinctive than that it has relegated food, i.e., food as nourishment, to a subordinate place among the objects for which men labor (Jefferson, 1925: 184).

This change may be further illustrated by Table 7 which shows the changes in tractor power and human labor on the farm. By 1969 the tractor had reduced the demand for human labor by some 9,975 million man-hours.

The "power" revolution only started with tractorization. It continued with the addition of power-driven implements and equipment for other farm tasks:

> After the general purpose type tractor, in quick succession came the self-propelled grain combine, the rice harvester, the corn picker, and the cotton picker . . . We now have mechanical harvesters for almost every crop . . . (Ibid: 16).

Insofar as modifying the rural landscape is concerned, the effects of mechanization are the result of the aggregate of all changes in farm technology. Mechanization and landscape changes are bound together; man and machine have altered the landscape on a macro scale, as in acreages released for cultivation due to

Table 7

MECHANICAL POWER VERSUS HUMAN POWER ON THE FARM

Year	Tractor h.p. (millions)	Man-hours (millions)	costs of operating (millions)
1920	5	13,406	(not available)
1950	93	6,922	5,640
1960	154	4,590	8,310
1969	203	3,431	11,500

Source: Rodefeld, et al, 1978: 46.

tractorization and on a micro scale, as is seen in the changes in farmsteads that result from greater efficacy in farm production.

CHAPTER V

CHANGES IN THE RURAL LANDSCAPE

The Look of the Countryside

On the macro scale, farm mechanization (particularly tractorization) has resulted in a change in the "look of the land" in the Midwest from that of an "untamed" prairie, to the presence of vast stretches of cultivated acreage. It has change the rural landscape by criss-crossing it with roads and railways that link rural communities and facilitate transporting farm produce to processing centers. The marketing of produce is only possible with an adequate transportation system. Such a system was partially financed by rural dwellers whose success in farming enhanced the prosperity of market towns and manufacturing centers:

> The process by which the agricultural surpluses of the Midwest were distributed can be divided into three stages. In the case of grain, the first stage was the concentration of the surplus in the great primary markets of the Midwest . . . The second stage involved the shipment of grain from the primary markets to some ninety secondary markets in the East and South . . . The third stage was the distribution of the grain within the territory immediately surrounding the secondary markets, and exportation abroad (Bogue and Wright, 1970: 239-240).

The increased movement from farm to local market, to primary markets was only possible with the building of adequate rural roads and the use of motor vehicles, especially farm trucks:

> . . . before the introduction of trucks the market point used by a certain group of farmers averaged 7 miles from the farm. After the introduction of trucks the average distance to market points was 18 miles (Eisenhower, 1930: 18).

Since agricultural surpluses created a greater need for good roads, it became politically expedient to mollify farmers who had persistently asked for a better rural road system. Moving the old steam-tractors, and later the gas-tractors and trucks, required all-weather roads. The cumulative affects of the advent of the auto and tractor aided the national effort to improve rural roads, particularly after Rural Free Delivery Postal Service began. Pragmatism won the debate over whether to improve rural roads:

> The cheap transportation secured by the use of better roads, which in turn favors the increased used of mechanical power, will enable the extension of the zone around each marketing center in which certain bulky and perishable products can profitably be raised (Ellis and Rumely, 1911: 304).

The linkages between the isolated farmsteads, the local market town, and the larger urban centers, illustrate the geographic, social, and economic interdependence of rural and urban areas. The amount of rural land taken up by road systems is much greater than we tend to recognize:

> The Economic Research Service of the USDA reports that rural highways and roads cover about 21 million acres of land (Blobaum, in Rural America, 1978: 393).

Ties to markets also have changed from local to world-wide, with increased specialization on farms. Since World War I, the Midwest has remained a "breadbasket to the world," implying the dependence of other nations on American ability to produce wheat and other grains. The road systems developed throughout rural areas serve to facilitate the movement of crops from farm to world markets. The types of roads depended upon traffic in rural areas to urban areas:

1. Local or Farm to Market Traffic
2. Farm to Farm Traffic
3. Inter-city Traffic
4. Inter-county and Inter-state Traffic (Agg, 1920: 4-5).

Farm mechanization also has led to a greater dependence on fossil fuels in order to meet human nutritional needs:

> . . . powering the more than five million tractors in the United States requires eight billion gallons of fuel--the equivalent of the energy content of the food produced (Clark, in <u>Rural America</u>, 1978: 95).

As a result of the dependence on fossil fuels, rural areas have been affected by strip mining as energy needs have increased. Farm power requirements have exacerbated the resource management problems in rural areas. Our chief concern is how these changes in land use have affected the landscape and whether such modifications have been ecologically sound:

> Man is a constant modifier of the land. Often, his modifications have been beneficial, as large areas of barren land have been protected and made productive. But man's ecosystem simplification has not always brought positive results. Soil has eroded from millions of acres that were overgrazed and overfarmed through ignorance and greed (Miller, 1975: 151).

The application of technology in agriculture has been both a boon and a bane to the rural landscape. While it has made possible the production of food on a massive scale, it also has created a landscape far different than Thomas Jefferson's agrarian ideal:

> . . . in addition to encouraging larger farms, mechanical equipment encourages an increasingly artifical

> topography . . . So with the advent of the newer, more complex processing machines there came into the landscape new kinds of rows, new spaces and intervals, and new locations for roads and irrigation apparatus (Jackson, 1971: 34).

Negative affects on the landscape from inappropriate farming practices include erosion, and a loss of plant diversity due to increased specialization. Erosion, a significant macro affect of tractorization, resulted particularly from plowing semiarid areas which have experienced major losses of soil. The droughts of 1934-1936 led to severe dessication in the Midwest and elsewhere in the nation's interior, an event commonly referred to as the "dust bowl days." Conservation practices were initiated after the harsh lessons of the 1930s:

> In the north central states . . . tree windbreaks or shelterbelts are commonly planted to reduce wind velocity and to control snow accumulation. From 6 to 12 rows are usually planted on the north and west sides of the farmstead. The shelter belts may be 125 to 150 feet wide and offer wind protection for a distance equivalent to 10 times the tree height. Snow will accumulate for 50 to 100 feet . . . on the lee side of the shelterbelt (Whitaker, 1979: 28).

Midwestern farmers planted thousands of shelter belts in order to alleviate wind erosion problems.

During recent decades many of those shelterbelts have been removed, resulting in ofter severe top-soil loss, particularly in mild winters when there is little snow cover. Table 8 shows average annual soil loss from various field practices.

Modern farmers have access to very specific information concerning prevention of soil loss. Textbooks on farmstead planning include sections on the ideal location and types of windbreaks needed. Table 9 illustrates a typical recommended plan. Even though the shelterbelts were planted on farmsteads, they constituted a macro change in the landscape, due to the acreages they consumed.

The primary macro impact of tractorization was in land remodeling. land was cleared of stones, trees and brush; marshes were drained; previously uncultivated soil was tilled; ditches were dug; hills were terraced; and drainage tiles were placed in fields; other macro impacts of tractorization included removal of stumps, levelling land, crushing limestone, applying fertilizer, and otherwise changing the topography or look of the land. (Encyclopaedia Britannica, 1942). Landscape transformation was due largely to implements adapted to tractor use. The sheer cumulative affects of changes in the landscape are awesome:

Table 8

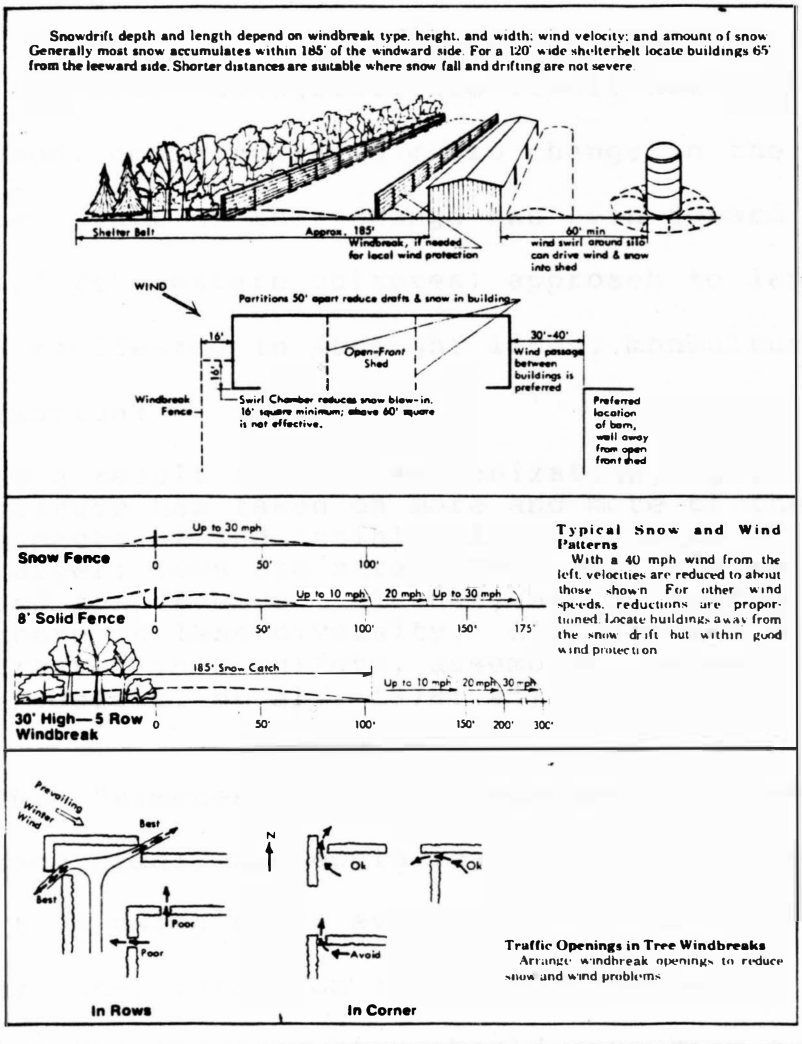
SOIL LOSS UNDER VARIOUS TREATMENTS

Average Annual Soil Loss	
Rotation-plowed cornland, sloping rows	7 tons/acre
Rotation-plowed cornland, contour rows	2 tons/acre
No-tillage mulched cornland, contour rows	Trace
Wheatland	1 ton/acre
Meadowland	Trace
Soil Loss under Severe Test:	5 inches of rain in 12 hours (July 5, 1969)
Rotation-plowed cornland, sloping rows	22 tons/acre
Rotation-plowed cornland, contour rows	3 tons/acre
No-tillage mulch cornland, contour rows	0.03 tons/acre

Source: Kern and Kern, 1977: 93.

Table 9

WINDBREAK PLANNING



Source: Boyd, James S., Practical Farm Buildings, 1977: 9.

> The chief value of land remodeling is however neither soil and water conservation nor the creation of more cultivable land: it is the creation of large flat, uniform surfaces for modern farm equipment. The larger the farm the more economic justification for mechanization; this is the best--indeed the only way of saving time and labor (Jackson, 1971: 34)

The "look" of agriculture itself has been transformed, constituting a macro change in the rural landscape. Part of that change has been toward a more "rational" (to western cultures) approach to land-use, which is manifested in straight lines, monculture, and specialization:

> As a result of this mechanization, agriculture has taken on more and more of the aspects of industrialization. Fields are larger; rows are straighter; ditch-banks and fencerows are cleaner, and altogether there is less diversity. All acreage is treated in a uniform, assembly-line way (Fodefelt, et al., 1978: 45).

This "sameness" in the landscape is monotonous, and in some cases, non-ecological. Farmers sometimes are so intent on using every available inch of farm ground today that they farm from fencerow to fencerow, forgetting the lessons which should have been taught during the dust bowl days.

The impression of the development of American agricultural growth upon the world has been dramatic. The ability to grow so much food--with huge, marketable surpluses--has tied the farmer to an ever-widening community.

The farmer is tied to world markets, to international monetary institutions, and to international issues, such as providing for the nutritional needs of the world's poor and hungry. Not all of these conditions are the result of tractorization alone, but tractors did make possible the cultivation of some of the richest soil in the world. The ability to grow an abundance of food, combined with our particular social-humanitarian values--and economic pragmatism--have made the United States the food larder for much of the world. These real yet often indirect consequences of the tractorization of American farms are of particular importance:

> American agriculture in its swift conquest of a vast domain is unique in the history of the world. Europe was slowly subdued during three millenniums, by civilized men. America was suddenly found as an empty continent, providing a ready overflow for crowded Europe. The American achievement is and seems likely to remain without a parallel (Anonymous, _Journal of Geography_, Feb. 1922: 49).

These are some of the chief macro changes in the rural landscape directly or indirectly resulting from the adoption of tractors. Though the degree of their influence upon the landscape varies, they constitute an inter-related series of landscape changes.

Changes in Farm Size

The largest "element" within rural areas is the "farm." Farms have increased in size partially as a result of the labor-saving advantages of tractorization. Farmers bought or rented more land in order to use the man-hours saved by switching from horse power to tractor power:

> In most cases, machine tillage actually extracts lower yields (pounds of food per acre) than labor-intensive agriculture. Essentially the use of machines saves (displaces) labor and is otherwise irrelevant to yield (Rodefeld, et al, 1978 :254).

The yield per acre was affected less by tractorization than by other changes in agriculture, such as the hybridization of seeds and application of pesticides and fertilizers. The tractorization of farms actually stimulated the reseach into those changes in agriculture. To economically operate tractors, farmers needed to harvest higher yields per acre. Due to heavy investment in tractors, farmers needed a guaranteed return for their labor. Farms in the Midwest, as in the rest of the United states, were affected by the combination of informational and technological advances that resulted in greater productivity:

> The modern Middle Western farmer relies on a veritable laboratory of chemicals to fertilize his soil and

> to eradicate weed and insect pests. A successful farmer must have at least two tractors plus an impressive array of other farm machinery. The efficient operation of new and larger machines demands larger fields and larger farms (Hart, 1972: 272).

To acquire larger machines, farmers needed more capital, the cost of which could be offset by increasing acreages farmed. As farmers rented or bought more acreage to cultivate, their machinery costs per acre decreased:

> From 1947 to 1962, adjustment in farming proceeded very rapidly. Enlargement was the pervasive theme. Farmers acquired the ability to handle more acreage through mechanization and struggled to stay ahead of dwindling profit margins by increasing their volume. So there was much consolidation of farms (Beale, _Rural U.S.A._, 1978: 40).

In the tractorization of American agriculture, few farmers stopped at buying a single tractor. Most farmers also invested in implements, accessories, specialized equipment, and additional (usually smaller) tractors. At the same time, farm size increased (generally on the "tractored" farms as farmers were able to do more work with machines than could be done previously with draft animals.) This led to a cycle of mechanization-consolidation-increased cost-increased production-and even more mechanization.

In Minnesota, for example, farm sizes increased from an average of 169.7 acres in 1900 to 235 acres in 1964 (See Maps 2-5). At the same time, the numbers of farms in Minnesota decreased from 156,000 in 1900 to 131,000 in 1964 an overall reduction of 25,000 farms (Bureau of the Census, 1975: 459). Changes in average acres per farm in Minnesota (1880-1969) are shown on Table 10.

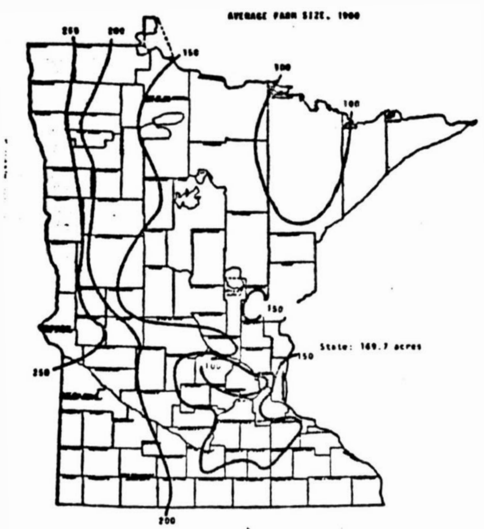
Western Minnesota historically had larger farms than those found in the remainder of the state. In the northwestern sector, the Red River Valley area was the location of the big "Bonanza" farms. In Southwestern Minnesota, there are vast acres of flat terrain, particulary suitable to tractor use. In eastern and southeastern Minnesota, dairy farms predominate on the hilly terrain. The eastern part of the state is also where poorer soils are found (Map 6).

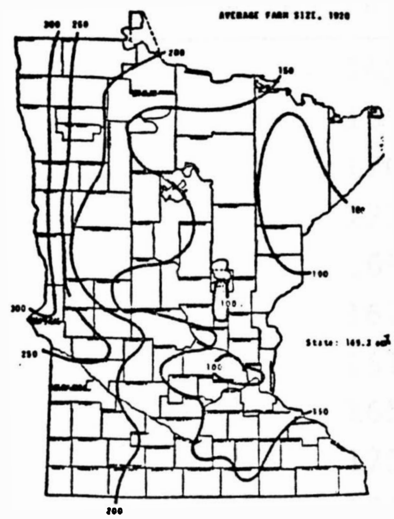
Northeastern Minnesota is heavily wooded and has smaller sized farms than are found elsewhere in the state. Mining and lumbering, rather than farming, are the primary economic activities in the northeast.

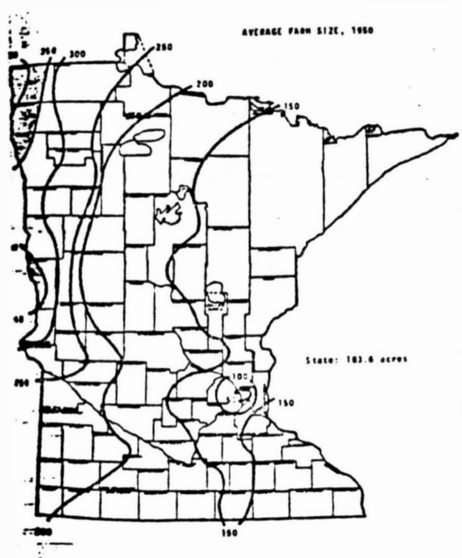
Minnesota is fairly typical of the Midwestern states where the greatest impacts of tractorization occurred. In the Midwest as a region, the average farm size was fairly stable until 1935:

Maps 2, 3, 4, 5,

AVERAGE FARM SIZE:
1900, 1920, 1950, 1964 RESPECTIVELY







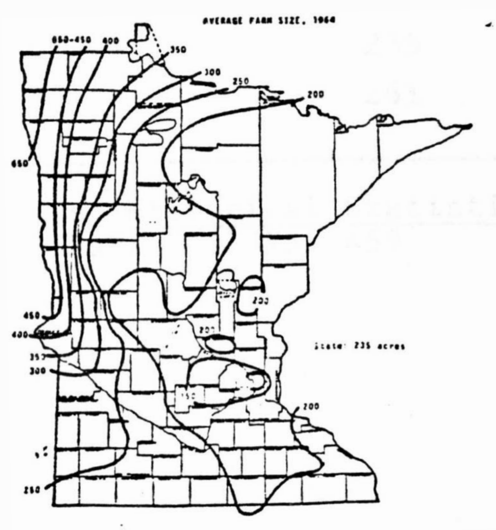


Table 10

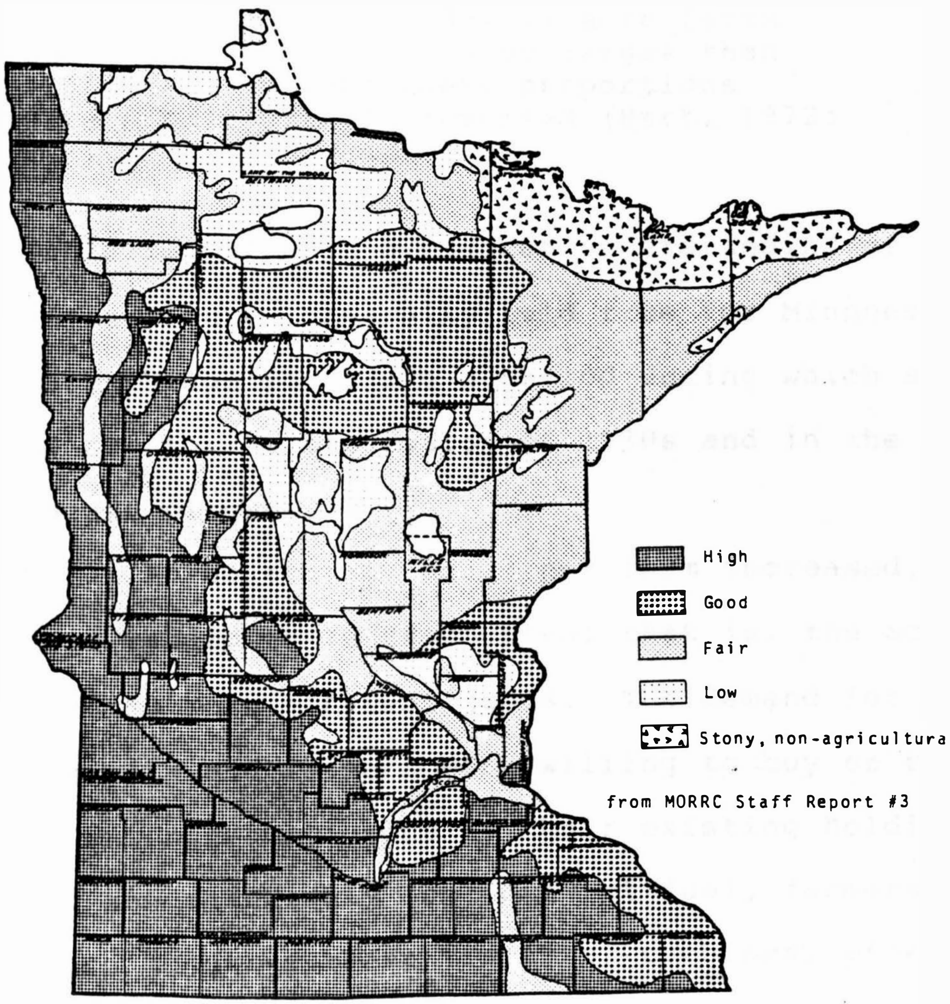
AVERAGE ACRES PER FARM IN MINNESOTA

Year	Acres Per Farm
1880	145
1890	160
1900	170
1910	177
1920	169
1930	167
1935	161
1940	165
1945	175
1950	184
1954	195
1959	211
1964	235
1969	261

Source: Bureau of the Census, Historical Statistics of the United States, Part I, 1975: 459.

Map 6

INHERENT SOIL FERTILITY



Source: Borchert and Yaeger, 1968: 9.

> The acreage of farm land in various size categories in the eight Middle Western states remained remarkably stable between 1900 and 1935. Since 1935 the principal change has been an increase in the amount of land in farms of 50 to 179 acres and an increase in the amount of land in farms larger than 259 acres. In 1935 roughly half the land was in 50-179 acre farms and a quarter was in farms larger than 259 acres; in 1964 these proportions were almost exactly reversed (Hart, 1972: 273).

Table 11 presents a clearer understanding of these data. These figures generally hold true for Minnnesota farm sizes, though there was a period during which size decreased due to the Depression of 1930s and in the 1920s due to locust plagues.

While total average acres per farm increased, those farms tended to be fragmented; that is, the acres per farm often were non-contiguous. The demand for land exceeded supply and farmers were willing to buy or rent land that was non-contiguous to their existing holdings. Because of the relatively low costs of fuel, farmers could afford to drive their tractors, combines, pickers, and balers to most distant fields:

> Farm layouts in Minnesota and elsewhere imply a readiness, if not an eagerness on the part of farmers to operate tracts wherever available within a reasonable thirty to forty minute commute (Smith, 1975: 69).

Table 11

CHANGES IN MIDWESTERN FARM SIZES
1935 & 1964

Year	percent	acres
1935	50	50-179 acres
	25	more than 259 acres
1964	25	50-179 acres
	50	more than 259 acres

Adapted from: Hart, 1972: 273.

The pattern of fragmented farms upon the rural landscape may be construed as an affect of tractorization and agricultural mechanization on both the marco and micro scales:

> Fragmented farming in the United States is synonymous with large-scale, successful agricultural operations. Minnesota samples revealed threats to the survival of farms without dispersed tracts, for they are generally too small. The geography of individual farm operating units suggests reconsideration of the image of the American farm. The declining number of large-scale operators, contrary to impressions construed from the term "consolidation," are not absorbing adjacent land parcels into larger contiguous farm units (Smith,1975: 69-70).

In terms of acreage included, fragmented farms are evidence of man's macro-scale modifications of the rural landscape. Ownership of the land and farming practices are demonstrably linked to the degree of mechanization and tractorization on farms. That a farmer's fields are non-contiguous may be due more to the imposition of the grid system upon the land, than from tractorization. The acquisition of tractors and the consolidation--and fragmentation--of farms are interrelated with a host of other factors in landscape modification.

Patterns of Farm-Shapes

Township maps show the rectangular pattern of farm shapes that have resulted from the alienation of land via the "quarter-section" system. There are 19 possible configurations of 40-acre square tracts that typify quarter-section farms, particularly in the Midwest, where the bulk of the land was alienated using the Township and Range system. Figure 10 shows the configurations found in southeastern Minnesota.

The "quarter-section" is mentioned because of the affects of attempting to farms contiguous versus non-contiguous tracts. Figure 11 shows the 19 configurations that resulted from the grid system, as of 1957. The implementation of the grid system influenced the ease with which a particular farmer could acquire more acreage as his efficiency increased due to tractorization which gave impetus to consolidation of acreage. The imprint of the quarter section on the rural landscape is still visible:

> Today, a hundred years after the first pattern of land ownership was set in southeastern Minnesota, many adjacent fields on the contour still clearly reflect the rectangular pattern when seen from a plane (Johnson, 1957: 348).

Consolidation and fragmentation of farms are reflected in field usage and pattern, as well as in farm

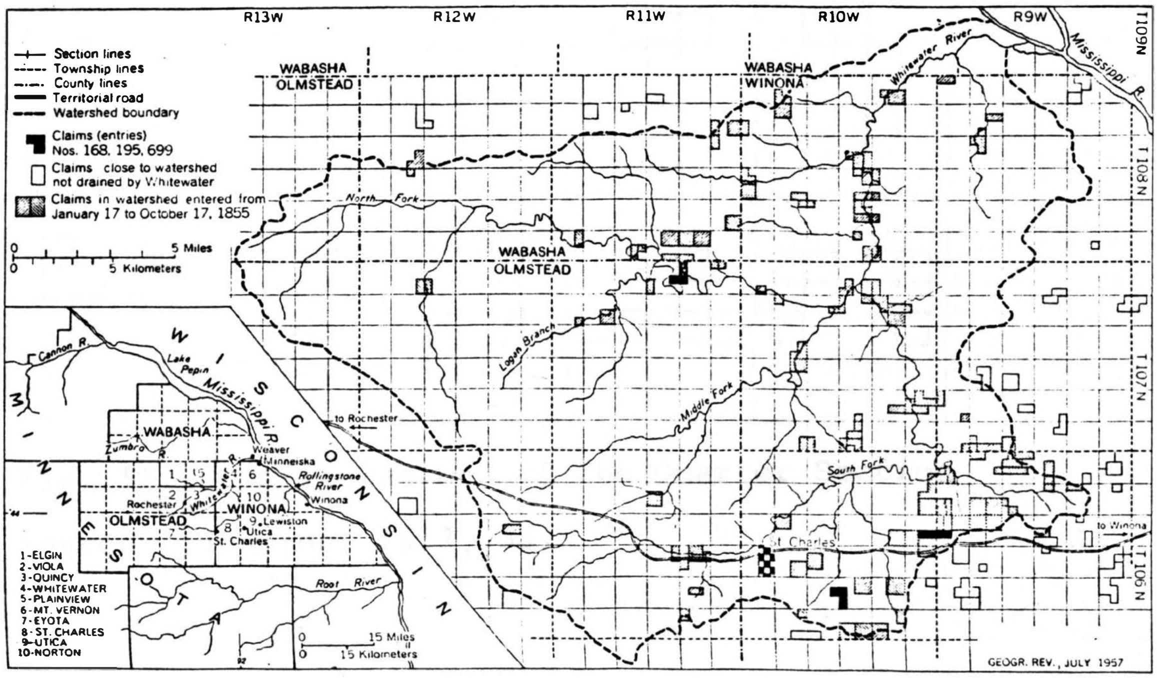


Fig. 10. Quarter-Section Farms in Southeastern Minnesota

Source: Johnson, 1957: 332.

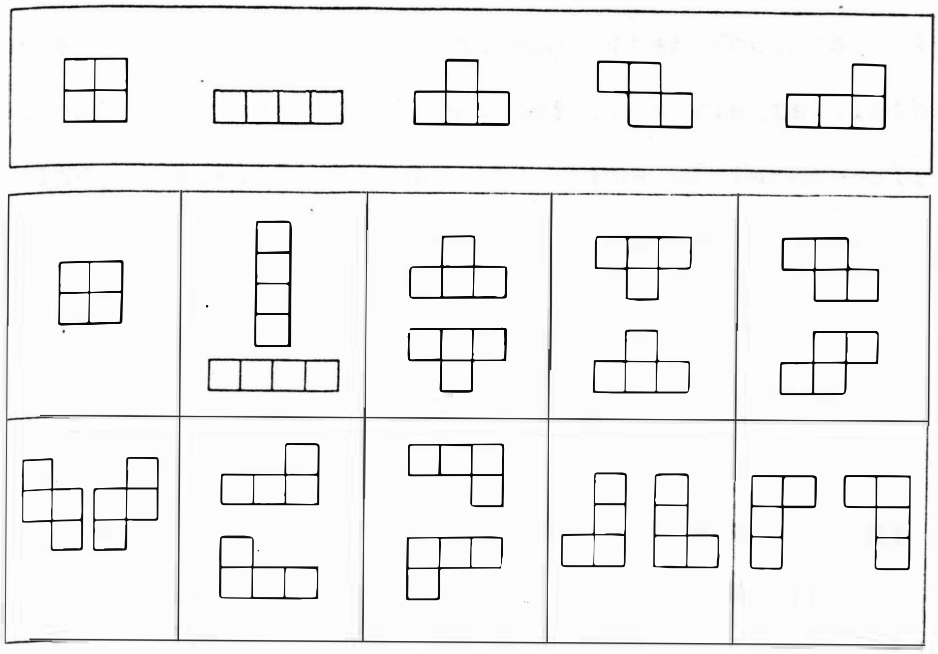


Fig. 11. Configurations of the Quarter Section

Source: Johnson, 1957: 339.

arrangements. Just as increased use of power machinery has affected land-use, it has also affected farmers attitudes toward the land. One example is the shift from the farm as "home" to "production center" as a result of tractorization and other factors. A certain local and regional character or style is visible in the size, shape, locations and types of farms--all of which have been influenced to some degree by tractorization.

Changes in Fields

The total cultivated acreage in the United States constitutes a macro portion of the rural landscape. Field patterns upon the landscape are related to the size of farms and their configuration, the degree of tractorization, and local conditions of physical geography. The cultivation of various crops involves varying procedures in farming. In general, farmers tend to follow certain rules regarding the layout of their fields, often with unintended negative impacts upon the land:

> The master plan with a field layout along cardinal directions was functional for level land, but disfunctional for rectangular fields or slopes (Johnson, 1974: 18).

Using tractors, certain considerations are fundamental to farming: saving time, labor and operating costs; providing for proper spacing per plant in the total plant population; and insuring adequate drainage of the fields (Jones, 1938: 396). Of these, the primary concern was often simply saving time. As a result, farming practices often have caused a decrease in soil fertility, increased erosion, and general practice of "exploiting" the land:

> A farmers in the Middle West thinks in terms of large regular fields as entitles, and he cannot afford the luxury of making allowances for variations within any particular field; in effect, he largely ignores the physical environment (Hart, 1972: 282).

When farmers used horses to farm, their attitude toward the land was almost reverential. With the advent of tractors on the farm, increased production became the dominant goal. Subsequently, a transformation occurred in the look of the rural landscape--due to changes in farm practices using tractors and other machinery--and changing rural cultural values.

Plowing with tractors involved adapting to the rectangular imprint of the land by plowing rectangular fields. Rows were usually as long as the tract and farmers used every possible tract. Parallel rows dominate the rural landscape; even the "turning radius" of the tractor is cropped in many cases.

Figure 12 shows the affects of plowing with tractors and special implements, and the parallel rows that result.

Figure 13 presents an aerial view of the rectangularization of fields, taken in 1957. It is a view of section 5 in Eureka Township, Dakota County, Minnesota (southeastern Minnesota). The rectangular look of the field is evident. The fields shown in the northeast quarter of section 5 are only about 10 to 20 acres, which is in contrast to fields in western Miinesota that are from 100 to 160 acres.

The farmstead shown is nearly centrally located in the section with windbreaks on the west and south sides of the buildings, which is a fairly typical arrangement. An alternative arrangement is the placement of the windbreak on the north and west sides of the farmstead. Many factors are involved in the siting of windbreaks, so no strict generalizations can be made.

A survey of aerial photographs taken of southeastern Minnesota (Dakota County) revealed no set pattern of field orientation, other than in the cardinal directions. The quarter-section shown from Eureka township is fairly typical of farm patterns in the area. As consolidation has occurred, there have been fewer farms per section than previously, but no

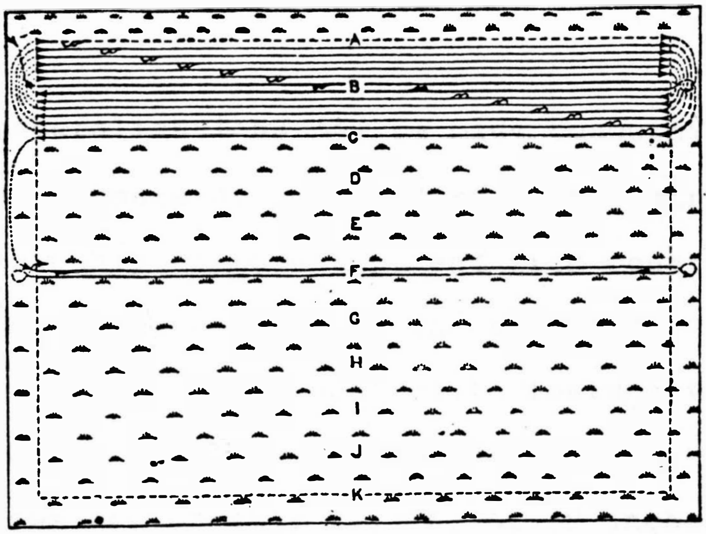


Fig. 12. The Look of the Field

Source: Jones, 1938: 399.

Fig. 13. Aerial Photo of Fields

Source: Agricultural Stabilization and Conservation Service, Farmington, MN.

generalizations may be made concerning an average number of farmsteads per section. The average varies from township to township, and from county to county in the southeastern part of the state.

The most noticeable feature visible in the rural landscape is the standardization of the look of fields. Rows are exactly 24, 36, or 48 inches apart, and run in either a north-south or an east-west direction (except in areas where center pivot irrigation is practiced:

> Plow cultivation and more intensive use of the land lead to parallelism, the practice of keeping equal distance between rows. When contiguity of fields is desired, whether for full use, as an irrigated or drained land, or for neighborliness . . . or for fair assessment and larger revenue, the rectangular pattern is inevitable (Johnson, 1957) 348).

The rectangular pattern is occasionally interspersed with contour and terrace farming, but these conservation practices are being abandoned in some areas. The Agricultural Extension Service of the University of Minnesota issued a warning to farmers as recently as November, 1982, citing the hazards of abandoning contour farming. In a newsletter to variuos agencies, Clifton Halsey, Soil Conservationist for the University of Minnesota, stated some of the reasons for the abandonment of contouring:

> . . . Many farmers abandoned contouring strips as they got larger tillage implements, cropped more land, or change to more row crops and less hay. Soil Erosion has increased considerably on sloping fields which are now mostly row-cropped (U. of M., U.S. D.A.,"NEWS" Nov. 5,1983: 1).

Tractorization has resulted in changes in the macro look of the rural landscape, and in the very remodelling of hilly terrain. The highly mechanized farms with several tractors have an incredible capacity to create an entirely man-made topography. The acquisition of even more sophisticated power-driven machinery, the consolidation and fragmentation of farms, increased production costs, and low market prices for farm products are all inter-related factors in the re-making of the rural landscape. Tractorization has been the primary impetus in this re-making of farms, fields, and farmsteads. The effects of tractorization on farmsteads included an increase in rational planning, which is discussed in the following chapter.

CHAPTER VI

THE FARMSTEAD

Rational Planning and Industrialization

Most farms in the United States changed little before tractorization. The electrification of farms in the 1930s, the mechanization of on-site farm operations, and the revolution of "power" for tractors and other implements caused many changes in the "look" and function of the farmstead. By the 1940s, tractors already had provided the impetus for the amalgamation of farms, as well as changes in the function of the farmstead from "home" to "production center." By the 1950s the uses of "power" on the farm transformed the ways in which farmers conducted their day-to-day operation:

> Electrical power transformed the steading in the 1950s. Power had two main effects. Crop drying or conditioning, particularly of grain, became a normal farm task and, with it, the capacity to mill and mix livestock fodder. Second, heat and ventilation to stock buildings became practical and with this the intensive housing of animals and, eventually, the factory farm, which can be divorced from agricultural land like any other industry (Weller, 1982: 15)

The 1960s was a decade of great technological advances which were coupled with changes in management practices on the farm. Older wooden farm structures were being replaced with metal units that were pre-fabricated systems for quick construction. These buildings were larger than the wooden sheds, smokehouses, and milk houses they replaced, and they were not symbiotic with the "natural agrarian landscape." With the advent of full-confinement facilities and automated feeding systems with computerized control panels, by the 1970s the homestead began to look like an industrial plant:

> In a much less familiar guise the machine dominates another part of the farm: the headquarters. . . the area looks much like an industrial plant, with its long metal sheds and barns and its neatly parked farm equipment (Jackson, in Zube and Zube, 1971: 35).

Changing cultural values are reflected in the look of the farmstead. Farm buildings on the farmstead still center around the house and barn, but the function of those farm buildings has changed with intensive tractorization and mechanization of the farm. Table 12 shows suggested requirements for planning a homestead. Farmers looked at their requirements very rationally and sought professional planning to get the layout and the structures best suited to their operations.

Changes in the costs and availablity of materials for building construction led to a loss of status for the

Table 12

PLANNING THE FARMSTEAD

Home	Layout
View	Spacing for fire safety & from odors
Near driveway	
Good water supply	Silos & feed storage located to allow for barn expansion
Septic tank & drainage field	
Garden	Driveway width & location
Play area	Turnaround diameter
Garage	Farm pond possibilities
Wind protection	Wind & snow control
Parking space	Full use of sunshine

Source: Whitaker, James H. Agricultural Buildings and Structures, 1979: 31.

old wooden barn and other buildings. Metal came into use because it is relatively inexpensive and presents less of a fire hazard than dry wood. Some farms no longer have any wooden buildings other than the farm house:

> No longer is a farm building a fixture in the sense of having continuity. It is equipment which, like a tractor, has a short, depreciated life. Most modern farm buildings have an economic life of ten years (Weller, 1982: 16).

Farming is no longer a "way-of-life," for even many of those farmers who still claim that it is. Though many families would prefer to farm, if operations do not provide an adequate means, the farmer must sell out. In order to assure that "way-of-life" will continue on the farm, most farmers have highly mechanized farmsteads, which have dramatically altered the farm family's links with their own rural past. The commercialization of agriculture and the transformation of the "family-sized" farm to the factory farm are inextricably linked to tractorization.

An example of the trend toward the "factory farm" look of the homestead can be seen on the typical Midwestern grain farm. The production of grain involves using high-powered tractors and combines, after which the "factory system" really comes into play. Transporting the grain requires a truck and wagon. If the farmer uses a pit-silo or granary, the grain is conveyed with power equipment. The drying requires a controlled facility or bin. Storing the grain requires large bins, upright silos, sealed silos, or smaller bins. Processing the grain for on-farm use requires a grinder, and automatic blender-grinder, or a transport grinder-mixer. Feeding the grain requires a conveyor or self-loading wagon to get the grain to the cattle barn or shed. Often the in-barn feeding system is entirely automated (Whitaker, 1979: 484-485).

Farmsteads obviously have been affected by a need for specialized equipment and structures. Whereas original settlers often used their own judgment for locating the farmstead operations, today's farmer seeks professional advice from salesmen who have precise calculations of the space and facilities required for various operations. "Farmstead planning" is often touted as the appropriate way to maximize farm efficiency, by relegating certain activities to "zones" that range a specified distance from the house site. Figure 14 shows one perception of recommended zones.

Rational planning to separate farmstead activities often imposes a dramatic change in rural cultural values. To centralize functions, farm buildings are consciously spaced and placed on the farmstead so as to maximize efficiency in production, with little regard to the "look of the farmstead." If any thought is given to the "look . . ." it is in terms of further rectangularizing the farmstead by aligning buildings in cardinal directions, into "efficient" squares and rectangles of activities such as the hog operation in one "block" and the grain operation in another "block." Though the diagram in Figure 11 seems to imply curves or even circles of activity, the layouts of buildings within those zones are most often in straight lines, so that in some cases the whole effect is like one huge manufacturing plant.

The factors which have increased mechanization in farming, and thereby enhanced the effects upon the landscape, are seen in Figure 15. This chart shows several factors which led to the decline in family-sized farms. Moving from left to right, the difficulty of farm work and the other factors listed contributed to the development of farm technology. In the second column is a range of topics that are inter-related to farm activities and their likelihood of changing the rural landscape. The third column shows the results of the forces that tended to give an impetus to enlarging farms, the rise of corporate farming, and the differentiation of farm structures and ownership. Finally, in the fourth column, we see the end results of the changes in farm

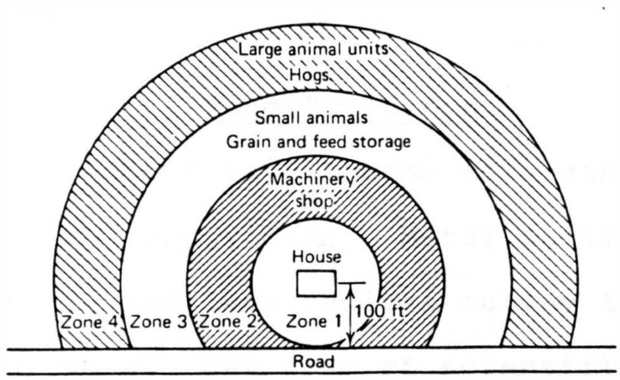


Fig. 14. Farmstead Planning Zones. (Each activity zone is 100 ft (30 m) wide. A visual aid for locating buildings and activities on a farmstead layout plan).

Source: Whitaker, 1979: 26.

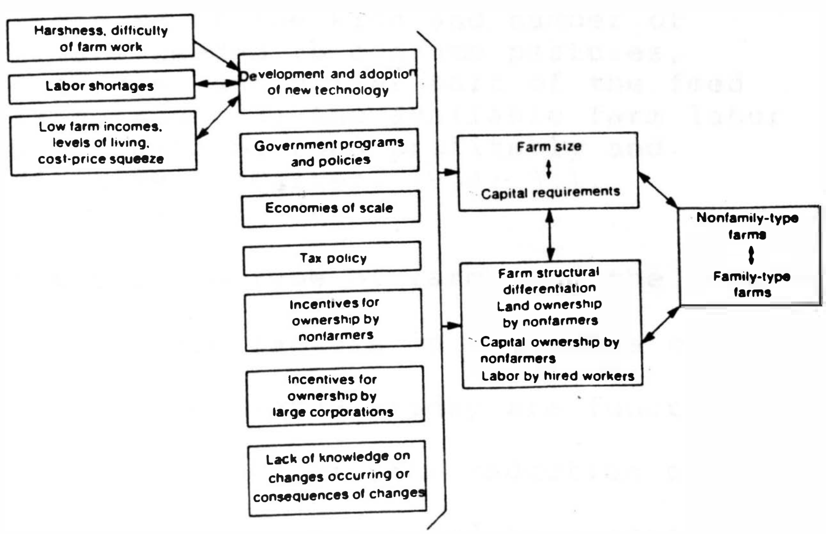


Fig. 15. Increased Mechanization Enhancing the Affects Upon the Landscape.

Source: Rodefeld, 1978: 234.

technology, with fewer family farms, and presumably, more "factory farms."

Farm Buildings

Farm buildings have become more simplified since the old horse-and-buggy days. Metal buildings require less maintenance and less capital outlay than do similar structures of wood. The rise of scientific knowledge of seed, feed, and the proper processing and storage of crops has changed the type and function of farm buildings:

> Ideally the farm-building improvements should be such that: (1) crops can be stored on the farm until they are fed or marketed, (2) the barns and sheds will take care of the kind and number of animals needed to consume pastures, roughages, and all or part of the feed grain, and (3) the available farm labor supply will be used profitably and effectively (Carter, 1954: 31).

Climate, the type of farm, and the type of management also are factors in the types of farm buildings used. Buildings today are functional rather than decorative. Need for the reduction of capital investments in buildings has led to a greater uniformity in designs and plans for pre-built sheds and barns. A typology of farm buildings and other farmstead features includes the following:

> Garage, hog house, sheep shed, machine shed, corn crib, granary, windmill, silo, barn, farm house, shop, farrowing houses, shop, cattle containment buildings, poultry house, brooder house, storage barn, individual hog house, and odd buildings (adapted from Trewartha, 1948: 204).

In addition, there are the various yards, and pens, and the garden, wood lot, orchard, and driveway, on the farmstead. Increased mechanization has brought about a change in farm buildings with a trend toward larger, simplified structures, and more grain storage facilities on farms:

> The dynamic nature of agriculture has caused many changes in farm buildings. Better seed and the use of fertilizers have increased the production on farms and use of large farm machines has made it possible for one farm to produce many times more crops. This brought the need for large grain storages and mechanical equipment to handle grain within the storage (Boyd, 1979: 2).

The type of farm determines the buildings likely to be found on it:

> The type of farming and the size of the enterprise determine the variety, mumber, and value of buildings required. Dairying, most livestock production, and mixed, general farming often require extensive building layouts (Collier, 1960: 318).

Grain farms already have been discussed. In the Midwest, dairying and livestock production have increased since the "horse era." As a result, the buildings on those types of farms also have changed. For beef production, made possible largely through the ability to produce surplus grain (due to tractorization), buildings are categorized by three types:

> Although beef housing systems vary greatly, they may be classified as: open lot system; barn and lot system; and the total confinement system (Whitaker, 1979: 354).

Total confinement systems provide a factory production of beef for the consumer market. In the confinement system, little labor is required from the farmer, other than to push the control buttons. The farmer may spend most of his time growing and processing grain and hay, and transporting cattle to markets.

In the dairy industry, intensive mechanization has occurred with a change in dairy barns:

> The tin pail has been replaced with thousands of dollars' worth of pipelines, bulk tanks, wash tanks, refrigerators, water heaters, vacuum milkers and large ranch-type masonry buildings (Drache, 1970: 26).

Changes in the dairy industry have had more to do with the electrification of farms, than with tractorization.

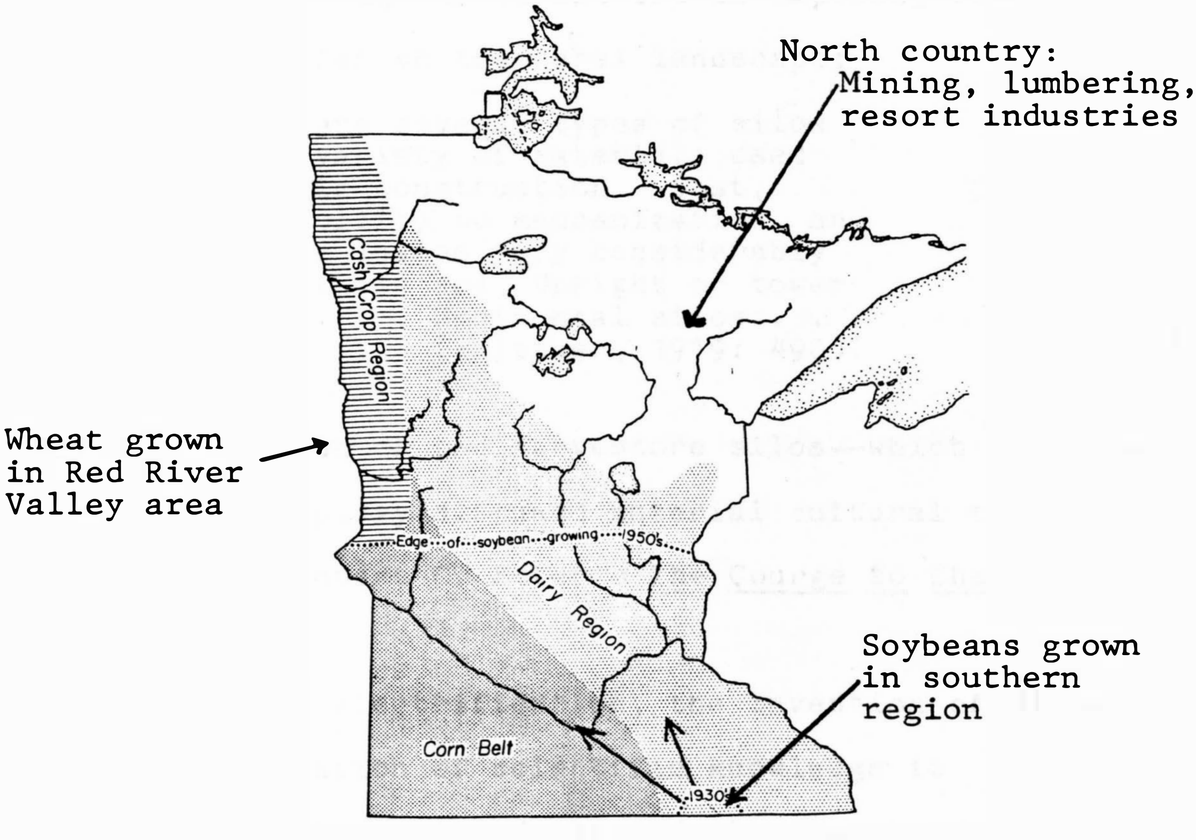
Historically, the dairy industry developed rapidly in the 1870s-1890s due to low grain prices. The silo was first constructed in 1873 and provided storage of feed year round, which greatly helped the dairy industry. Tractorization affected dairying due to the ability to grow more corn for feed. In Minnesota, for example, with its shorter growing season, it became more economical to use immature corn as silage rather than allowing it to mature and risk loss of the crop to an early frost. With hybridization of seeds better adapted to shorter growing seasons and colder weather, corn yields increased with a growth in corn cash-cropping. The dairy region in Minnesota is concentrated in the eastern part of the state where hilly terrain is less suitable for growing wheat and soybeans. The hilly pastures are an excellent source of roughage for dairy animals:

> A concentration on dairy farming in Wisconsin and Minnesota can be related to the abundance of roughage, such as corn silage, hay, and pasture on farms in the cooler lands north of the Corn Belt (Hart, 1972: 269).

Map 7 shows the corn (also wheat and soybean) regions and the dairy and cash-crop regions of Minnesota. This map dates from 1959, and the trends since that time include growing more soybeans, and increased livestock production in the southern part of the state.

Map 7

FARMING IN MINNESOTA



Source: Borchert, 1959: 43.

Silos are typically made of wood, metal, brick, or concrete. For many urban dwellers, the relative "wealth" of the farm is often judged by the number (and height) of silos present on a farm. Silos typically are tall, cylindrical storage units and are an imposing feature visible for miles on the rural landscape:

> There are several types of silos and a variety of materials used in their construction. Cost, adaptability to mechanization, and storage losses vary considerably . . .[there are] Upright or tower silos . . . Horizontal silos . . . Stacks. . . (Whitaker, 1979: 490).

For a discussion of the Harvestore silos--which were one of the most rapidly diffused material cultural traits in history--see Robert C. Suter's _The Courge to Change_ (1965).

Besides electrification, the invention of silos, and the application of scientific knowledge to corn-hybridization, the dairy industry has been most influenced by the advent of refrigeration:

> About 1875 refrigerator cars were first used for transporting perishable farm probucts. The centrifugal seperator for seperating cream from milk, invented in Sweden, was brought to the United States in 1882 (Ebeling, 1979: 209).

For the most part, the dairy industy has been much less affected by tractorization than from a combination of other factors. Dairy buildings have been influenced as much by public demands for the type and quality of dairy products desired by the consumer, as by tractorization.

> Market demands such as those for refrigerated food, cleaner dairy products, rapidly grown baby beef, lamb, and broilers have affected the design of farm buildings, by necessary changes to meet production requirements (Ellis and Rumely, 1911: 3)

Whether the farm is a dairy farm, a beef production farm, a grain farm, or a general mixed farming operation, today the key words in agricultural building advertisements are "systems handling":

> In a system approach all the possible methods of managing and handling the necessary items for an enterprise are considered both seperately and in combination. Once the overall combine system has been decided upon, it is possible to choose a structure to house that system (Whitaker, !979: 307).

Using the systems approach, the farmer is encouraged to analyze the flow of materials from the field to processing machines, to storage units, to feed systems in order to determine the types of building he needs and their inefficient arrangement in a time-work-flow pattern:

> One of the important aspects of farm mechanization is materials

> handling . . . The key to successful mechanization is the planning organization of a materials 'flow pattern as it relates to machinery and equipment and to future expansion (Whitaker, 1979: 482).

The layout of farm buildings is affected by the "systems approach" philosophy as farmers seek to use their time and labor for maximum cost-effectiveness and production. The affect of this philosophy may be seen in types and function of farm buildings. Barns, machine sheds, and animal production buildings now look like metal or concrete factories.

The Barn

J. B. Jackson discusses the changes in the uses and "look" of the barn in his article "An Engineered Environment," which appeared in *Changing Rural Landscapes*:

> The barn is not a shelter any more, it is a machine closely involved in the productive process . . . many new barns are machines which process their contents; provide animals with the correct amount of light and heat and air and space; preserve, prepare and distribute feed (Zube and Zube, 1971: 36).

Whereas the old wooden barn was a permanent structure on the farm (and often the only remaining artifact of the earliest homesteading), metal barns seem to be impermanent structures, threatened by wind and rust. Wooden barns began to be replaced by ready-built metal buildings beginning in 1920 (Collier, 1960: 322). Though many wooden barns still stand, their usefulness has been seriously diminished by cultural changes due to tractorization and increased scientific kowledge of animal production requirements. Wooden barns seem to be obsolete relics of a bygone era, though many will continue to be used until they fall ruin.

Machine Sheds

The cost of tractors and their implements made machine sheds a necessity on farms. First there were tractors, then combines, harvesters, corn pickers, hay balers, and a host of other specialized farm equipment which needed protection from the elements:

> The reliability of farm machines contributes to the timely completion of production operation . . . The purpose of machinery storage is to offer protection from weather, theft, and vandalism, and to allow easy maintenance and adjustment of machines (Whitaker, 1979: 500).

An early indication of the need for a specific shelter for machines came in 1910 when the cost of sheltering horses was compared to sheltering machines which could do the same (and more) work:

> The cost of a building for sheltering a 25 H.P. tractors is approximately one-tenth of that required to shelter 25 horses and their food supply for a year ("The Gas Engine," July 1910: 322).

Today the farmer's investment in machinery may be as much or more than that which he has in the land he farms. Modern tractors and combines may cost $125,000, and require constant maintenance. Buildings which are specifically designed to shelter farm machinery typically are one of three types:

> 1. Narrow, open-sided shed . . .
> 2. Wide, open-sided shed . . .
> 3. Wide, enclosed shed (Whitaker, 1979: 510).

Machine sheds usually are pre-built metal units and come in various sizes, depending on the farmer's requirements. Since there is now so much machinery, farmers store their equipment in any available space, as no single shed is big enough. Farmers who use the old horse barn for machine storage know they risk losing expensive equipment from fire. Metal sheds offer the most economical and practical solution for storing the bulk of farm equipment. There are five main groups of equipment, depending on the type of work for which they are intended:

1. prime-movers, including engines of all kinds, tractors, water-wheels, windmills, and so forth;

2. cultivating machinery, including ploughs of all kinds, rotary tillers, harrows, hoes, scarifiers, rollers, manure distributers, drills;

3. harvesting machinery, including mowers, rakes, swath-turners, tedders, reapers, self-binders, threshing machines, elevators, potato-lifters, beet toppers, etc.;

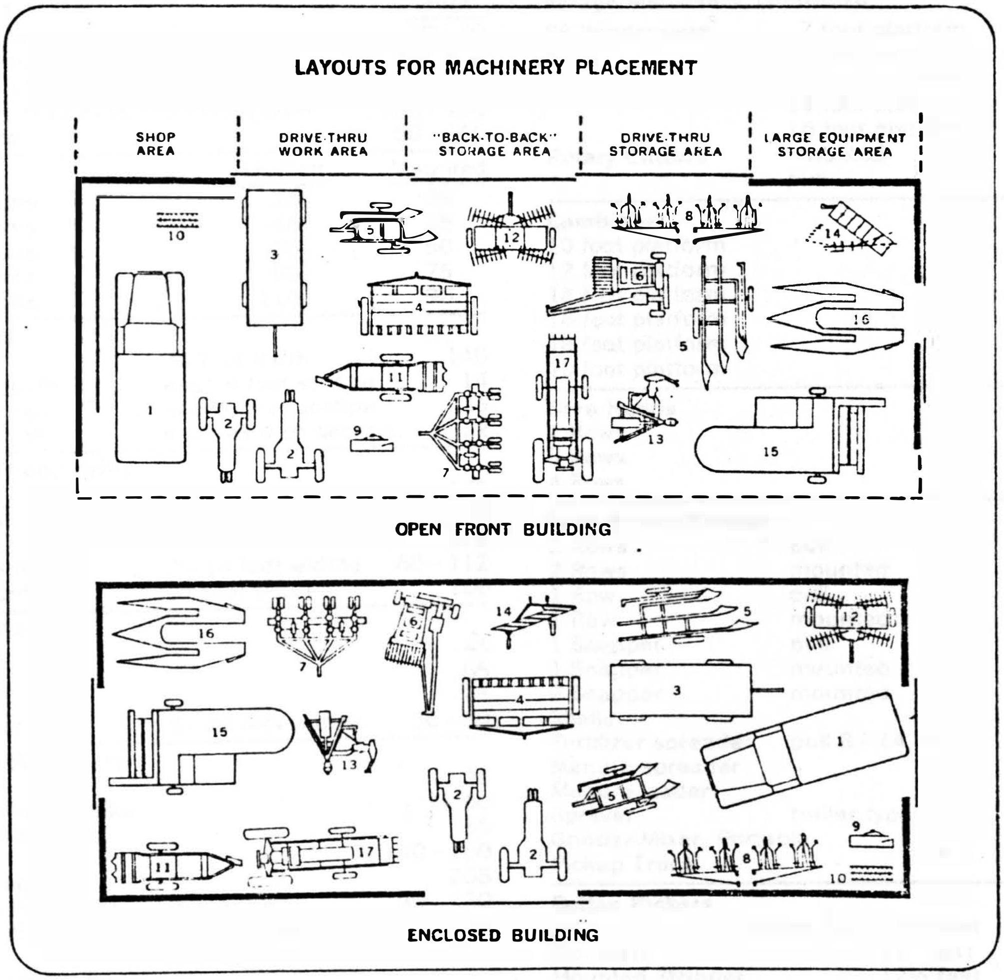
4. stationary or barn machinery, including such food-preparing machines as cake-breakers, chaff cutters, grinding and crushing mills, and root cutters;

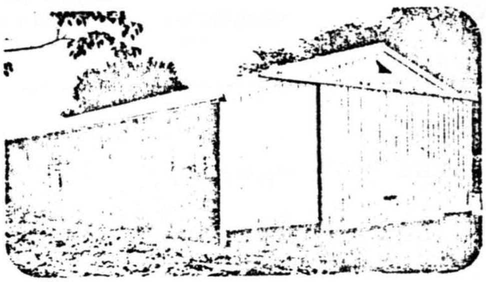
5. dairy machinery, including milking machines, separators, churns, butter workers, sterilizing and bottling machines (*Encyclopedia Britannica*,1942: 372).

Even more specialized equipment has been developed since the foregoing typology of equipment was written, but the list gives a general idea of the amount and variety of farm machinery which requires shelter. Figures 16 and 17 show the requirements for space in equipment storage, and the typical layout of farm machinery in machinery sheds. Since many farms have all or most of the equipment listed, the amount of storage facilities required can be quite extensive. Several sheds devoted to machine storage area are generally required.

Agriculture and Tractorization

The types of equipment now used in farming indicate one facet of the agricultural revolution in the United States since the initial transition from





KEY TO EQUIPMENT

1. TRUCK
2. ROW CROP TRACTORS
3. WAGON
4. GRAIN DRILL
5. PLOWS--2 & 3 BOTTOM
6. FORAGE HARVESTER
7. CORN PLANTERS 2 & 4 ROW
8. CORN CULTIVATORS 2 & 4 ROW
9. BLADE GRADER
10. SPIKED TOOTH HARROW
11. MANURE SPREADER
12. TANDEM DISC
13. MOWER
14. SIDE DELIVERY RAKE
15. ONE MAN COMBINE
16. MOUNTED CORN PICKER
17. TRACTOR WITH MOUNTED MANURE SCOOP

Fig. 16. Layouts for Machinery Placement

Source: Boyd, James S., Practical Farm Buildings, 1979: 242.

FLOOR SPACE REQUIRED FOR FARM MACHINES

Tractors		Square Feet
25 - 40 horsepower		70 - 80
40 - 70 horsepower		80 - 100
70 - 100 horsepower		100 - 120
4-wheel drive over 100 horsepower		120 - 130
Crawlers		60 - 100

Plows	Trailing	Mounted
2 Bottoms	25	20
3 Bottoms	45	35
4 Bottoms	65	50
5 Bottoms	90	75
6 Bottoms	115	90

Harrows		
Disk	14 foot width	140
Spring tooth	each 4 foot section	14
Spike tooth	each 6 foot section	36
Rotary Hoe	each 42 inch section	12
Planters and Drills		
4 Rows		135
6 Rows		200
8 Rows		266
Grain drill	7 - 14 foot widths	60 - 112
Press drill	14 foot width	150
Cultivators		
4 Rows		45
6 Rows		65
8 Rows		85
Field cultivator	8 - 20 foot widths	30 - 80
Forage Machinery		
Mower		25
Side Delivery Rake		60
Hay Conditioner		55
Baler		140 - 180
Bale Wagon		208
Forage Harvester	pull or SP	90 - 130
Forage Blower	hopper-type	40
	conveyor	90
Unloading Wagon or Bunk Feeder	rectangular	130
	"V"	80

Forage Machinery, continued		Square Feet
SP Windrowers	7 foot platform	105
	10 foot platform	120
	12 foot platform	135
	14 foot platform	150
	16 foot platform	165
Rotary Cutters	mounted	25 - 60
	pull	66 - 170
Combines*		
10 foot platform		250
12 foot platform		280
14 foot platform		370
16 foot platform		420
18 foot platform		500
20 foot platform		550
Corn Heads		
2 Rows		50
3 Rows		65
4 Rows		85
Corn Picker-Shellers		
2 Rows	pull	180
2 Rows	mounted	136 - 160
1 Row	pull	80
1 Row	mounted	135 - 150
1 Snapper	pull	80 - 120
1 Snapper	mounted	70 - 80
2 Snapper	mounted	136
Sheller		20
Fertilizer spreader	pull 8 - 14 foot	30 - 50
Manure spreader		100
Manure loader		85
Sprayer	trailer type	70
Grinder-Mixer, Portable		100
Pickup Truck		240
Cotton Pickers		
SP	approx. ht.—14½ feet	185
Mounted	14 feet	155 - 180
Mounted Stripper	12½ feet	125 - 160

**Allow 13-foot door height minimum.*

Fig. 17. Storage for Farm Machines

Source: Boyd, 1979: 241.

horse-farming to tractor-farming. There have been several advances which have increased the impact of tractorization upon the rural landscape:

> Major Agricultural Revolutions in the United States since 1920 include:
> 1. Synthetic fertilizers
> 2. Animal to fossil fuel power
> 3. Pesticides
> 4. Feedlots
> 5. Genetic selection and hybridization
> 6. Large scale and specialized production
> 7. Storage, processing, distribution, and marketing . . . (Miller, 1975: 125).

Tractorization alone cannot account for the tremendous advances in agricultural production and it would be facetious to imply that it created the rural landscape that we see today. That tractorization made many of the other changes in agricultural technology possible and more readily applicable cannot be denied. The rural landscape continues to be altered by man's quest for food:

> Man's quest for more food is based on using three levels of energy input to supplement the solar energy used by plants in photosynthesis; these three levels are (1) manpower, (2) manpower plus animal power, and (3) manpower plus fossil fuel power. As we have seen, increased yields in modern agriculture are based on four fossil fuel powered technologies: mechanization, irrigation, fertilizers, and pesticides and herbicides (Miller, 1975: 128).

As the limits of the economies of scale in increasing yields from the land are reached, the affects of tractorization go down. Tractors are unlikely to get any bigger, or much better. The affects of tractorization have been studied from a conservationists' viewpoint in recent years. As a result, some writers have encouraged a return to smaller tractors, which may be more economical and less detrimental to the land than have been some modern tractors. The future of farming with tractors is the focus of much speculation. However, the past is well documented, as is discussed in the concluding chapter.

CHAPTER VII

CONCLUSIONS AND PERSPECTIVE

"From Horse to Horsepower: Farm Tractorization and the Rural Landscape" assesses the effects of tractorization on rural material cultural traits and the "look of the rural landscape." The central question was "how has switching from using horses to using steam-and fossil fuel-powered tractors affected the rural landscape at the time of the transition?" From that question, this study has broadened its scope to include the latent affects of tractorization which in some measure have been of a sociological nature. Since "cultural ways" influence material cultural traits, it has been appropriate to study the transition in farm power and technology in order to better understand why the rural landscape has evolved as it has. This study has found that "tractorization" is not always solely responsible for many changes in the rural landscape, but remains of critical importance as an innovation which contributed to so many changes.

The "immediate" effects of tractorization are those which occurred as tractorization replaced horse-farming. Some of those effects are of an obviously geographical nature, whereas others are indirectly linked to geographical changes in the landscape.

The "latent" effects of the tractorization of American farms refers to those effects which were "delayed reactions" to the transition from using horses to tractors (1880-1914).

The "direct" impacts of tractorization on rural landscape changes are those which are attributable to tractorization and the general mechanization of agriculture largely made possible by tractorization. "Direct" affects of tractorization are in contrast to "indirect" affects, which are the result of tractorization's impact on the agricultural and national economies, as well as upon the character of American society itself.

"Macro" changes in the landscape include those which occured over large-scale areas, whereas "micro" changes in the landscape refers to those which occurred either as small-scale changes or which were of relatively less importance than "macro" impacts.

Using these terms, a typology of changes in the rural landscape can be derived which categorizes the various affects of tractorization:

1. direct-immediate (macro) affects
2. direct-latent (macro) affects

3. indirect-immediate (macro) affects
4. indirect-latent (macro) affects
5. direct-immediate (micro) affects
6. direct-latent (micro) affects
7. indirect-immediate (micro) affects
8. indirect-latent (micro) affects

Since every change is either macro or micro in nature, a simplified typology may be derived. Table 13 presents a summary list of impacts from "tractorization," according to their typology.

Because of the broad nature of this study, many changes in the landscape may have been overlooked. Using this typology, they may also be categorized according to their relationships to "tractorization." Not all the changes in the landscape are of a geographical nature, but in reviewing the findings of this study, one can conclude that tractorization has had a surprising range of impacts upon the landscape. Even those changes in the landscape with which most people are familiar illustrate the revolutionary impact of tractorization in agriculture. We tend to take modern agriculture (and the rural landscape) for granted, as though things have always been as we see them today. The genesis of the rural landscape is made clearer by understanding the role tractorization has played in agriculture.

	Immediate *	Latent
Direct	I	II
Indirect	III	IV

* Macro (M) or micro (m) impacts on the landscape

Fig. 18. Typology of Landscape Changes

Table 13

IMPACTS OF TRACTORIZATION

I. Direct-immediate impacts:

- Need for stronger bridges and all-weather roads
- Erosion and compaction of soil
- Land released for cultivation
- Started trend toward increased specialization in farming
- Increased the total acreages cultivated
- Less farm labor required
- Fewer horses, mules, and oxen on farms
- Growth of Midwest as grain-growing capitol of the world
- Increase in total "power" available on the farm
- Led to parallelism in the "look of the land"
- Change from Jeffersonian Agrarianism

II. Direct-latent impacts:

- Improved farm economy
- Fencerow-to-fencerow cultivation
- Large-scale erosion--"Dust bowl days"
- Loss of windbreaks
- Loss of land used for rural roads
- Function of farm buildings changed
- Industrialization of agriculture
- Great increase in amount and variety of equipment
- Consolidation of farms
- Increased farm sizes, with fewer farms
- Greater dependence on world markets for agricultural prices
- Shift from subsistence to commercial farms

III. Indirect-Immediate impacts:

- Growth of transportation networks (R.R.'s, barges, trucking)
- Need for shelterbelts
- Stimulated research testing seed, fertilization, hybridization
- Encouraged a re-designing of farm implements
- Growth of Agricultural Experiment Stations

Table 13 Continued

IV. Indirect-latent impacts:

- Rise of conservation movement (after Dust Bowl)
- Increased trade and world interdependence
- Greater involvement of U.S. government in farm policy decisions
- Greater government subsidization of agriculture
- Farm fragmentation
- Growth in livestock industries
- Growth in dairy industry
- Rise of "factory farm" system
- Trend toward "systems approach" in farmstead planning
- Transition from farming as a "way-of-life" to a "science" (business)
- Greater application of managerial skills in agriculture

The impacts cited in this study are not conclusive, but they do constitute the major effects of tractorization in the rural landscape. The questions posed in the Introduction as being the major research problems in this study, have been answered. Further inquiry into specific rural material cultural traits would be of particular interest to gain a better understanding of this subject. A study of the farmstead would be a welcome addition to the literature on rural matters. To date, few "farmstead" studies have been conducted, and those were of the southeastern United States. A study of Midwestern farmsteads would be appropriate because that is the region in which tractorization made its greatest imprint upon the rural landscape.

More of the older farmsteads are being abandoned as fewer farmers remain on the land. Part of our cultural heritage may be lost if the physical evidence of our rural past is allowed to sit in careless abandonment amidst the ruins of an older age. By studying the genesis of the farmstead, we can retain our rural ties, even if only in our literature. The rural landscape is a repository of our cultural heritage; it tells the epic of the making of a nation. An old barn which leans over more with every wind; a creaking, broken windmill; a fallen fence; a rusted horse drawn harrow lying in a ditch; these are part of our cultural baggage. Without understanding the country side, many of us are blissfully ignorant of the fragility of our lives.

As humans, we are dependent upon the food grown by the modern agricultural industry. Take away the fuel for the massive "horse-power" machinery, and we are suddenly thrust back to a bygone era. We refer nostalgically to that time as "the good ol' days." The sight of the horse in a pasture is a novelty to us now; most of us never knew the difficulty of farming with horses. While the use of machinery has had negative impacts upon the landscape, its use has increased mankind's food supply, thereby freeing time for most of the population in the United States and other "developed" countries to purse other endeavors. The rise of a civilization is dependent upon an adequate food supply, and this has been assured in the United States since the advent of tractorization. Solving the problems related to man's activities in modifying the face of the earth are part of an ongoing process begun by the first tool-making and tool-using humans.

"Tractorization" has not been a panacea for meeting man's food supply problem. That solution falls under the realm of political and social interaction among nations of the world. The historical factors that made it possible for tractors to have the impact upon American agriculture may not exist in other nations.

In America, at least, we can have an understanding of our particular good fortune in the geographical and social conditons which made the growth of the agricultural industry possible. When we drive through the countryside on our way to another city, perhaps we can appreciate the following bit of rural humor:

> Farmers are the heavily subsidised countrymen who get on the way of the townsmen who are trying to get away from the towns in order to enjoy the countryside which is their heritage and their birthright, especially if they claim farming ancestors. Farmers are the countrymen who are to be seen leaning on gates and pig-stye walls and those railings in cattle markets or on the bars of market town inns on market days. Farmers are those nasty-tempered gentlemen who get cross if you leave the gate open when you leave that luscious green field in which you have parked your car for a jolly picnic on your way to forget about about the nasty-tempered gentlemen who are giving you ulcers in your office most of the year. Farmers are beastly to animals. shutting them into confined spaces for the short lives they are permitted to have before they get eaten by townsmen and, perhaps worst of all, farmers just don't seem to understand that town dogs must be let out of cars to run about the coutryside, chasing sheep which, after all, must be great fun for the sheep as well as the town dogs. If it were not for the

> farmers, the countryside would be free for all townsmen to enjoy (Tickner, 1963: 61).

The sentiments expressed by Tickner may seem trivial, but they serve to underscore the "urban bias" which is rampant in American society. Perhaps by fostering an understanding of the rural landscape and of farming, fewer townsmen will be so condescending on their next drive through the countryside. Perhaps then the sight of a tractor in a field will evoke more than an image of a "rustic Americana."

GLOSSARY

accretion: adding acreage, such as a 40-acre or 80-acre tract of land, to an existing farm.

agriculture: the utilization of biological processes to produce food and other products useful to people.

all-purpose tractor: light-weight, low-priced tractor for any kind of field or stationary work.

amalgamation: adding a 160-acre contiguous tract to an existing farm.

belt or brake horsepower (b.hp.): power generated at the belt pulley and available for useful work.

combine: a harvesting machine that reaps and threshes grain crops while moving over the field, leaving the straw standing.

contour cultivation: cultivation of crops around hills at the same elevation.

disc harrow: an implement for breaking up soil with revolving discs, concave, circular, edged tools of hardened steel.

drawbar horsepower: power developed at the hitch or drawbar and available for pulling, dragging, or similar tractive effort.

drill: to plant in rows; to sow, as seeds, by dribbling them along a furrow or in a row.

English barn: designed for storage and processing of grain; no animals housed in it; used on farms where crop production is the chief activity.

erosion: the wearing away of land by wind and water.

factory farm: characterized by rationally planned units, often with metal buildings and sheds; often uses the "systems approach," with the chief aim to maximize and centralize farm functions and productivity.

farm: refers to the fields, farm structures, etc., generally understood to be included in agricultural production.

farmstead: the base of all operations that are involved in farming; where decisions are made, products gathered, livestock housed, and where pens, yards, and other elements of farm production are located.

farmstead planning: rational planning of farm layout, requirements, and centralization of activities, usually within zones of activity.

horsepower: (1) device by which the power of a horse is used to drive threshing (or other) machinery. (2) unit of measure of power, equal to the ability to raise 33,000 pounds one foot high per minute, as established by Boulton and Watt.

lugs: extensions on tractor wheel rims, used for traction in early models of tractors and some large modern tractors.

mechanized farming: generally refers to the entire gamut of inter-related machinery applied to agriculture; in the modern sense, refers to highly automated or power-driven equipment and machinery.

Midwest three-portal barn: derivation of crib barn; with three aisles with pens and cribs running from gable to gable; found extensively in the Midwest.

Middle West (Midwest): John Fraser Hart's definition includes Minnesota, Missouri, Illinois, Wisconsin, Iowa, Ohio, Indiana, and Michigan; see Introduction for Jackson's, Sauer's, and author's defintions.

Nebraska Tractor Tests: 1919, first law enacted to regulate the design, construction, and operation of farm tractors. The Nebraska laws required testing of tractors prior to granting of license to sell tractor models in Nebraska.

Pole barn: Midwestern barn, one-story high with gently sloping roof and walls, suspended on poles, found in prosperous agricultural regions.

power: rate at which work is done.

systems handling-approach: the planning and organization of a materials 'flow' pattern as it relates to machinery and equipment and to future expansion.

traction engine: general purpose engine for doing farm work.

tractor: a self-propelled machine for drawing other machines and for operating stationary machines.

tractorization: the process of displacing manual and animal labor on the farm by attaining tractors to do the same work.

Winnipeg contests: 1910 contest in Canada which pitted steam tractors and gasoline-tractors in various field operations in order to compare their adaptability for farm work; decisive event in encouraging the adoption of gas-tractors.

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