THE UNIVERSITY OF MANITOBA

AGRICULTURAL SETTLEMENT IN SOUTHERN MANITOBA, 1872 TO 1891: A PROCESS-FORM APPROACH

by

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ABSTRACT

This study analyses the process of first agricultural settlement and related settlement forms in a selected area of southern Manitoba between 1872 and 1891 in an attempt to explain agricultural settlement evolution. A model of the settlement process is formulated and incorporates economic variables based on measures of distance and the environment that are derived from rural settlement theory and empirical rural settlement studies. This process-model is tested with reality using descriptive statistics and stepwise multiple regression analysis in order to assess the effect of the variables on the date of entry of land. In addition a simple counterfactual is employed in order to analyse the effect of one variable in isolation. The relative significance of the distance and environmental variables changes through time, with a decline in the importance of the distance variables and an increase in the importance of the environmental variable of land quality. Results indicate that proximity of land to a railway loading point, the variable initially thought to be most crucial in the settlement process of the study area, is not the dominant variable in the years following railway construction and up to 1891. Two major achievements of this study are as follows. First, it is recognised that established rural settlement theory is not necessarily appropriate to detailed empirical analysis; second, it is recognised that empirical generalisations relating to the agricultural settlement of both Manitoba

and the prairie region, which were assumed to be applicable, are inappropriate to the study area in the period analysed. It is proposed that, in order to improve existing rural settlement theory, the institutional variable of cost of land be incorporated if theory is to be generally applicable to the North American settlement situation. A process-form methodology constitutes a valid research theme for historical geographical studies concerned with dynamic explanatory analyses.

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CHAPTER I

INTRODUCTION

The settlement history of Canada is a comparatively recent and rapid history. Permanent occupation of eastern Canada began in the early seventeenth century as one part of European overseas expansion, with a French colony being established along the lower St. Lawrence. The fur trade and subsistence agriculture provided the livelihood for these early settlers. Fur was the staple product and the trade of this staple was dependent on the demand created in Europe. By the middle of the nineteenth century Europe was the market for another North American economic staple, namely wheat. Unlike their eastern counterparts, most settlers arriving in pre-confederation Ontario had agricultural motives for settling in the region. Within a short time of arriving they were producing small surpluses of wheat which subsequently entered the export trade. As the agriculturally-based economy grew and diversified other sectors of the economy developed, so that by the 1850s towns and industries had become established and transport facilities were developing in southern Ontario. Migration to western Canada began in the 1870s. Fur trading posts were well established in the West but the new settlers were predominantly farmers interested in making a living in an economy based on agriculture rather than the fur trade. The objective of this study is to analyse the process

process of this first agricultural settlement and settlement forms in a selected area of southern Manitoba between 1872 and 1891 in order to attempt an explanation of agricultural settlement evolution.

1. Aims

This study, which examines the evolution of agricultural settlement in an area of southern Manitoba, has three aims. First, to formulate a model, or simplification, of the agricultural settlement process for southern Manitoba between 1872 and 1891. Second, to isolate and assess the importance of the principal variables in the settlement process which are assumed to have been of economic importance in the location decision-making process of the commercially-oriented settler. Variables included in the process are derived from rural settlement theory and empirical studies. Third, to analyse the settlement forms between 1872 and 1891 in relation to the formulated process.

2. Hypotheses

The most satisfactory method of testing a model against reality is by testing hypotheses incorporated in the model. Rural settlement theories proposed by Bylund (1960) and Hudson (1969) suggested that measures of distance and environment are the major explanatory variables of settlement location. Distance variables may include distance from entry point, major urban centre, or transport route such as a trail. Environmental variables include those relating to specific physical features and to land quality. In addition to the distance and environmental variables certain institutional variables are of relevance in the settlement process of the area being investigated.

Several hypotheses derived from rural settlement theory and related empirical works are tested empirically in an area experiencing agricultural settlement. The objective is to determine the effects of specific variables in the settlement process on the date of entry of a parcel of land and related settlement form. The hypotheses focus primarily on measures of distance and environment which are the principal variables identified in rural settlement theory. The principle of friction of distance, and hence accessibility in terms of time and distance measurements, lies behind the formulation of the hypotheses concerned with measures of distance. These hypotheses are as follows:

HYPOTHESIS (I): Date of entry is related to distance to the nearest trail, with those parcels of land nearer the trail being settled before those at a greater distance. Proximity to trails provides greater accessibility to parcels of land. Bylund (1960) suggested that settlers sought to minimise distance between their land and an available communication link. Weir (1964) further proposed that trails were a control in guiding the lines of settlement.

HYPOTHESIS (II): Date of entry is related to distance to the nearest railway loading point, with those parcels of land nearer the loading point being settled before those at a greater dis-

tance. Accessibility to railway loading points, for the transportation of both settlers and goods, is assumed to have been of importance to the early settlers (Friesen, 1963-64; Weir, 1960-61, 1964). Morton (1938, p. 73) noted that "as the railway preceded settlement, the settlers took up the land more or less in the immediate vicinity of the line." It is suggested that proximity to the railway loading point was the principal variable in the settlement process. Support for this suggestion is provided by the writings of Richtik (1971, p. 287), who found the railway to be the most important "institutional factor" in the settlement process, and by Mackintosh (1934, p. 46) who, writing about settlement in the early twentieth century, stated that "nearness to railways and to projected railways was of first importance to the settler."

HYPOTHESIS (III): Date of entry is related to distance to the nearest service centre, with those parcels of land nearer the centre having greater accessibility and being settled before those at a greater distance (Bylund, 1960).

HYPOTHESIS (IV): Date of entry is related to distance to the entry point, with those parcels of land nearer the entry point being settled before those at a greater distance (Hudson, 1969). In this study the principal entry point is Winnipeg.

The following hypotheses are designed to test the effect of environmental variations on date of entry.

HYPOTHESIS (V): Date of entry of a parcel of land is related to the presence or absence of flowing surface water and woodland, with those parcels possessing both of these environmental features being settled before those possessing only one or neither. Several authors have indicated the importance of the presence of water and wood to the early settlers (Morton, 1967; Murchie, 1936; Weir, 1964). Water was required for domestic and livestock use while wood was required for the construction of buildings and fences and as a source of fuel. With improved transport facilities the proximity to woodland declined in importance in the settler's location decision.

HYPOTHESIS (VI): Date of entry is related to land quality, with those parcels of land possessing land with the greatest soil capability for agriculture being occupied before those of inferior quality. In his settlement study of the rural municipality of Sifton in southwestern Manitoba, Loveridge (1977) found that the early settlers selected the best land available, regardless of its location.

The final hypothesis focuses on an institutional variable in the settlement process applicable specifically to western Canadian settlement.

HYPOTHESIS (VII): Free homestead lands are settled before lands of other dispositions (Loveridge, 1977). Most of the early settlers arriving in the rural municipality of Sifton in southwestern Manitoba between 1881 and 1885 took up free homestead lands (Loveridge, 1977).

3. Study Area

It is proposed in this study to formulate a model of the agricultural settlement process for southern Manitoba, focusing on individual rather than group settlement. A study area is selected which is representative of southern Manitoba and which is suited to the collection of the data required for the testing of the hypotheses. The area

chosen for this purpose embraces Townships 7 to 14, Ranges 10 to 16, west of the Principal Meridian (Figures 1 and 2). The area, comprising fifty-six townships, is approximately one-tenth of the total area which is west of the Red River and south of latitude 51 degrees North in present-day Manitoba. Only 30 percent of the study area was within the province of Manitoba in 1872, part being within the North-West Territories. The western boundary of the province was redefined in 1877 from latitude 99 degrees West to the line between Ranges 12 and 13, west of the Principal Meridian, thereby including a further 13 percent of the study area in Manitoba. Following the final extension of the western boundary in 1881, the entire study area became part of the enlarged province of Manitoba (Figure 1).

4. Study Period

This study examines the period from 1872 to 1891. During this time southern Manitoba developed from a relatively isolated unsettled area to an established agricultural region within a larger economic system. The migration of pioneer farmers to western Canada, beyond the Red River Colony, began in the early 1870s (Friesen, 1963-64; Richtik, 1975; Weir, 1960-61) and the first settlers to enter land in the sample analysed arrived in 1872. The date of survey formed a constraint to settlement, since an individual was not legally allowed to locate on unsurveyed land. The sectional system of survey had been approved originally in 1869, but it was not until 1871 that the section was fixed at 640 acres and the township at 36 sections. From 1871 onwards, southern Manitoba was subdivided using this method.

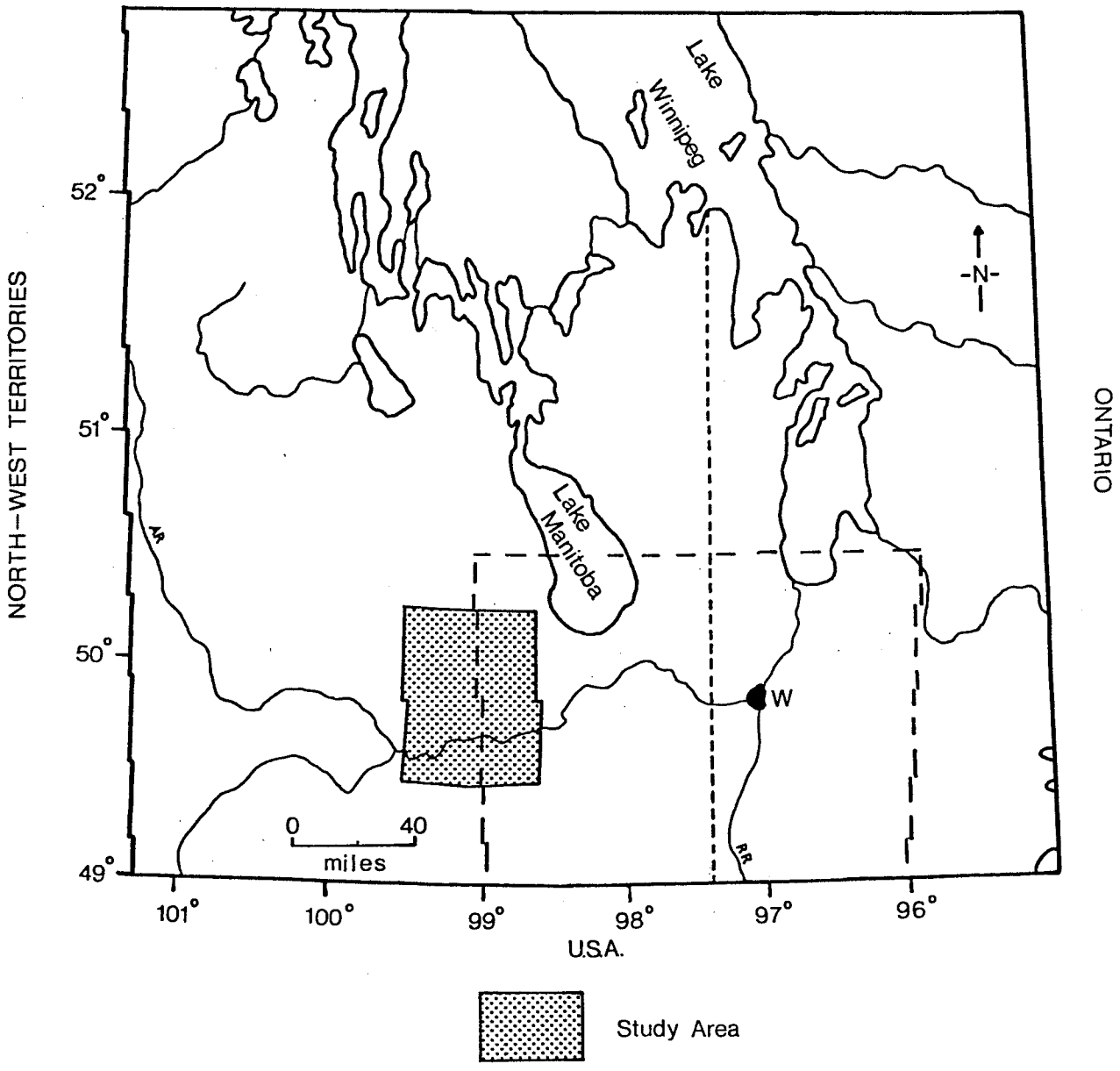
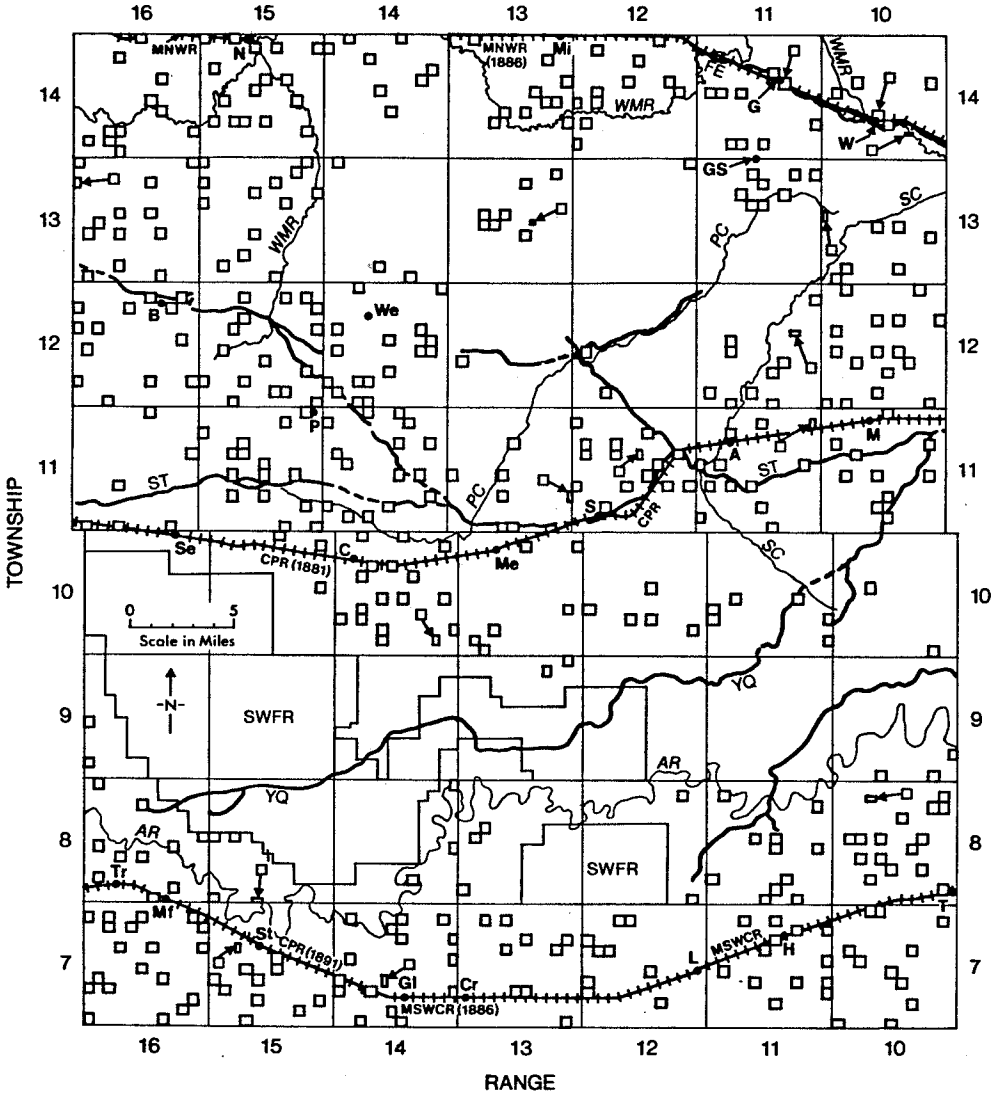


Figure 1. The Provincial Setting, 1891



SERVICE CENTRES

A	Austin (by 1881)	Mf	Millford (by 1891)
B	Brookdale (by 1891)	Mi	Midway (by 1886)
C	Carberry (by 1876)	N	Neepawa (by 1881)
CR	Cypress River (by 1886)	P	Petrel (by 1886)
G	Gladstone (by 1876)	S	Sidney (by 1881)
Gl	Glenboro (by 1886)	Se	Sewell (by 1881)
GS	Golden Stream (by 1876)	St	Stockton (by 1891)
H	Holland (by 1886)	T	Treherne (by 1886)
L	Landseer (by 1886)	Tr	Treesbank (by 1891)
M	MacGregor (by 1881)	We	Wellwood (by 1891)
Me	Melbourne (by 1881)	W	Woodside (by 1876)

TRAILS

FE	Fort Ellice Trail
ST	Saskatchewan Trail
YQ	Yellow Quill Trail

RIVERS

AR	Assiniboine River
PC	Pine Creek
SC	Squirrel Creek
WMR	Whitemud River

RAILWAYS

CPR	Canadian Pacific Railway
MNWR	Manitoba and North Western Railway
MSWCR	Manitoba South Western Colonization Railway
SWFR	Spruce Woods Forest Reserve

— Trail ++++ Railway □ Quarter Section Analysed

Figure 2. The Study Area

The establishment of a transport system is an essential component of the evolution of an economic landscape. In 1872 the area analysed was dissected only by a number of trails, but in 1881 the main line of the transcontinental Canadian Pacific Railway linked Portage-la-Prairie and Brandon, taking a route across the study area. By 1891 two additional major railway lines had become established in this area; the Manitoba and North Western Railway extended westwards from Portage-la-Prairie across several of the northern townships, while the Manitoba South Western Colonization Railway served the southern portion of the area (Figure 2). In 1872 no facilities existed in southern Manitoba to export agricultural goods from the region by a quick or efficient means but by 1891 a simple transport network had emerged which facilitated not only the in-movement of agricultural settlers but also, and perhaps more significantly, the export of agricultural goods to eastern Canada and Europe. The Manitoba farmer was thereby able to enter the world agricultural economy.

5. Data and Sources

The process of agricultural settlement is a complex process which involves a large number of events. Since it is not feasible to study every single event, a model of the settlement process is developed in order to study agricultural settlement evolution. The model is a simplification of the actual process, incorporating only the assumed most important variables influencing agricultural location decisions. Previous settlement studies indicate that these variables include measures of distance, environmental, institutional and personal factors. The formulated model considers only the economic variables in the

settler's decision, based on distance and environmental considerations, in an attempt to explain the date of settlement.

In this study, first agricultural settlement is analysed at the scale of the quarter section or part thereof. Data required for the testing of the hypotheses are collected principally from primary sources. The year in which each quarter section was entered is obtained from the township general registers held at the Crown Lands Branch of the Department of Mines and Natural Resources in Winnipeg, as well as from the Land Titles' Offices in Brandon, Morden, Neepawa and Portage-la-Prairie and the Archives at the Glenbow-Alberta Institute in Calgary. In addition, these same sources provide specific details, such as the acreage and nature of the grant type, for each unit of analysis. The date of survey of a specific quarter is obtained from surveyors' township diagrams and field notes held at the Surveys Branch of the Department of Mines and Natural Resources, Winnipeg. The same documents further provide the source for environmental information relating to water and woodland. Contemporary data relating to nineteenth century land quality are not available. Accordingly, the Canada Land Inventory classification of soil capability for agriculture is used to calculate a measure of land quality for each quarter section.

In addition to the environmental data, details of the location of trails, railways and service centres are obtained from railway plans and township diagrams held at the Surveys Branch and Land Titles' Offices, and from contemporary maps held in the map department of the Provincial Archives of Manitoba, Winnipeg. This information is subsequently transferred to 1:250,000 topographic maps from which the required distances are calculated.

6. Analysis

A random sample of 1000 quarter sections is taken within the study area. This is a representative sample size and forms 12.4 percent of the quarter sections in the area. Between 1872 and 1891, 461 of the selected quarter sections were settled and analysis is confined to these locations. Both the formulated settlement process and settlement forms are examined. In order to illustrate the change in process and form through time, settlement is analysed at five-year intervals, that is, in 1876, 1881, 1886 and 1891. The settlement process and related settlement forms are analysed using descriptive statistical analysis and stepwise multiple regression analysis. Stepwise multiple regression analysis is an appropriate means of testing the importance of variables in the model. Additional insight may be gained into the importance of specific variables in the process by the use of counterfactuals. Counterfactuals are hypothetical alternatives to reality and may be used to emphasise the importance, or question the assumed importance, of specific variables in the process. A further application of counterfactuals concerns the derivation of forms from only one variable in order to observe the effect of one variable in isolation. To this end a simple counterfactual is employed in this study of agricultural settlement.

7. Organisation of the Thesis

Chapter II reviews methodological approaches and a selection of empirical studies in historical geography and historical settlement geography. Further, the methodological approach adopted in this study is identified in this chapter. In Chapter III the sampling method and process of data collection are identified and the background to the

settlement of the study area is outlined, demonstrating that the selected area of southern Manitoba forms a part of the Prairies. In this chapter a selection of settlement studies of western Canada is reviewed to draw attention to the scale of previous analyses, the approaches used and the variables identified as being of significance in the settlement process. Chapter IV presents the formulation of the agricultural settlement process for the period between 1872 and 1891 together with the analysis of the settlement process and forms. The formulated model and the results obtained are discussed and assessed in Chapter V. In the final chapter conclusions are drawn regarding the settlement process and related forms and the approach employed in this study.

CHAPTER II

LITERATURE REVIEW: METHODOLOGY OF HISTORICAL GEOGRAPHY AND APPROACHES TO THE ANALYSIS OF SETTLEMENT

Various methodological approaches are used in historical settlement studies. These may be identified as being essentially descriptive or analytical. This chapter is divided into two parts; the first part considers four methodological approaches in historical geography and outlines the approach of this study, while the second part identifies the existing rural settlement theories and presents a discussion of empirical settlement studies, excluding those relating to the prairie region. The discussion focuses upon the approaches used, the scale of the analyses and the variables in the settlement process.

1. Methodology of Historical Geography

Several methodological approaches exist in historical geography, where established themes of study exist alongside emerging themes. Four approaches may be identified, namely studies of the geographic past, geographic change through time, the past in the present and the evolution of spatial form. Of these, the first three are established approaches, originally outlined by Prince (1969), while the fourth (Prince, 1978) is an emerging theme that has evolved as a response to the shortcomings of static form analysis.

(a) Study of the Past

Historical geography, according to Hartshorne (1939), was the geography of past periods, where a past period was selected and described in the same way as a contemporary regional study might have been made. Studies in historical geography investigated the "historical present" (Mackinder, 1930, p. 310) and were concerned with the functional interrelationships of phenomena in space at fixed points in time. These past geographies were static cross-sections of the past that were reconstructed using historical records such as, for example, the Domesday surveys which were used by Darby (1952) to recreate past geographies of England. Cross-sections provide a detailed picture of an area at a specific point in time but several criticisms can be levelled at their use in the study of past periods. A cross-section provides a static description of phenomena in space that is ahistorical in that it is both isolated from and not concerned with developments leading to its formation. The description provides only limited explanation of the development of the selected area and this is not increased by the presentation of a chronological succession of cross-sections. Arranged chronologically, a set of cross-sections may illustrate and describe changes in the landscape, but not provide an explanation of these changes. A further criticism of the cross-sectional approach is that the reconstructed region may be atypical. A particular area may have been reconstructed for a specific time because sufficient data were only available for that area at that time. Since the data need not necessarily be representative of a larger region, no generalisations can be made.

(b) Study of Change Through Time

Another established approach to the study of the past is the genetic approach advocated and used by Clark (1954). Clark (1954), critical of the static cross-sectional studies in historical geography, regarded any point in time as a momentary state in a process of change and argued that, in order to understand a given state, it was necessary to focus attention on its generating processes. Clark (1960) explicitly argued in favour of the geography of change and, unlike Sauer (1941), who stated that it was essential to understand the origins of a cultural landscape in order to study its evolution, believed it was necessary to go back only as far as was necessary to understand the present. It was not necessary to search for origins.

A number of different methods have been used in historical geography in an attempt to incorporate a temporal and explanatory element into the study of geographic change. A chronologically-arranged set of cross-sections does not account for the processes generating change since, by using this method, these processes can only be inferred from the region undergoing change. This is an unsatisfactory means of obtaining new knowledge for the change in the region in question may be due to a number of complex processes. Following his study of sequent occupance in northern New England, Whittlesey (1929) suggested that man altered his environment with his successive stages of occupance. Each stage was linked to the preceding and following stage with transformations occurring from one stage to the next but, in comparing sequent occupance to vegetation succession, Whittlesey did not take account of the fact that, unlike vegetation succession, human landscapes do not evolve through identical stages in a closed system. Instead, they may

develop in response to processes generated outside the region.

It may have been the recognition of the complexity of the processes generating landscape change which led historical geographers to write explanatory narratives of the way in which individual features of the landscape altered through time, rather than the way in which all features interrelated. Darby (1951), for example, used this chronological, vertical theme approach in his study of the changing English landscape. In this study he considered the development of individual features separately, successively investigating the clearing of the woodlands, the draining of marshes, the reclamation of the healthlands, the landscaping of the countryside, and the development of towns and industries. Although examining the changing landscape in considerable detail, the treatment of the themes as individual units failed to present an integrated whole which is essential to an explanation of landscape development through time. Jones (1974), in a review of more recent work by Darby (1973) on the historical geography of England, further emphasised the absence of any suggested causes of changing distributions. Clark (1960, p. 611), on the other hand, was aware of this shortcoming, arguing in favour of a greater emphasis "on the changing patterns of phenomena and relationships in and through area." In his study of the agricultural economy in Nova Scotia between 1851 and 1951, for example, Clark (1962) analysed the differential rates of change of several components of that economy. Specifically, he investigated the changing distribution of the values of the sheep/swine ratio, and the distribution of the values of change in that ratio, in an attempt to explain geographic change.

(c) Study of the Past in the Present

An additional means by which geographic change has been studied is by the retrogressive method (Baker, 1968) which has been particularly evident in the French school of geography. The purpose of this method is to work towards an understanding of the past by an examination of the present. In other words, the present is known and the objective is to derive earlier forms from the evidence of later forms.

Prince (1969, p. 113) stated that "all features in the present landscape are relict features, survivals from some past period." Some historical geographers have employed a retrospective approach in their studies of such relict features. This method, which argues that a knowledge of the past is indispensable to an understanding of the present landscape, examines the past in order to explain the relict features in the present. An example of such a relict feature in the landscape of western Canada is the sectional grid system of the original land survey.

(d) Study of the Evolution of Spatial Form

The analysis of processes constitutes a basic research theme in current human geography, following the awareness that static analyses, both in terms of the study of single points in time and of a succession of points, are unable to adequately explain how the form came about. Chisholm (1975) argued in favour of a dynamic rather than a static approach to the study of distributional patterns and Amedeo and Golledge (1975) emphasised the need to study the processes generating spatial form, in order to identify possible causes of the patterns. In order to explain the change in an observed distributional pattern, it is necessary to incorporate the time element so that a dynamic explanation

of its evolution may be achieved. According to Amedeo and Golledge (1975, p. 177): "we expect that the spatial manifestations of processes (i.e., "form") will change from one time period to the next, and, therefore, the time factor must be explicitly included for any complete modeling of a process and its spatial implications." Historical geographical studies of distributions are well suited to the adoption of a process-form approach as advocated by Amedeo and Golledge. A major objection to many studies in historical geography is the exclusion of a temporal component in their analyses of the location of phenomena in space. Baker (1976) noted the preoccupation of historical geographers with spatial patterns and the neglect of the generating process in spatial analytical studies. A focus on the descriptive analysis of form alone, excluding process, is an unsatisfactory means of explaining form. Although the operation of a process results in forms, a given form may result from any one of a number of processes, so that a focus on form alone can only lead to an inference of its generating process. The deduction of form from a hypothesised process, however, is a more reliable means of explanation, taking account of change in form through time (Harvey, 1967) and avoiding the inference problem. Such process-form reasoning as a means of studying spatial form evolution is a legitimate research theme in historical geography and has been advocated by Harvey (1967) who proposed the construction of models of spatial evolution in order to understand development over time and space. Harvey (1967, p. 597) argued the necessity of understanding "the principles that govern human organization over space." The adoption of a process-form approach in historical geographical studies is a response to inadequacies of static spatial analyses such as the study of past geog-

raphies (for example, Darby, 1952). Further, this procedure is a development of the change through time approach advocated by Clark (1954, p. 71) who stated that any particular study period could "be understood only in terms of the processes at work to produce it."

Amedeo and Golledge (1975) noted that one of the reasons why this type of reasoning is still in its infancy in human geography is due to the fact that the meaning of the concepts of "process" and "form" have not been established. Definitions of these concepts are difficult to find in the literature. In this study the term "process" is used to refer to a succession of actions of interacting variables which result continuously in an outcome. A "form" refers to the spatial outcome at any one point in time resulting from a particular process.

Two difficulties are noted in the application of a process-form procedure (Prince, 1978) where the process-form relationship is a cause-effect relationship. These are the problems of equifinality and indeterminacy. The problem of equifinality has already been noted and refers to the situation where different processes may result in a similar form. This demonstrates the danger inherent in inferring process from form. The problem is avoided if form is deduced from process, since the process used has been selected on specific theoretical, empirical, or both theoretical and empirical grounds. Indeterminacy indicates that a process may generate a number of different forms, where the observed is considered to belong to a larger set (Prince, 1978). This calls for an assessment of the probability of each state occurring and may be achieved by employing a simulation procedure. This technique aims to derive results from the operation of processes and is also a means of gaining a greater understanding of landscape evolution, a

factor which is ignored in spatial analysis. Simulation is a means of incorporating an element of chance or uncertainty into the process, whereby a probabilistic process approximates human behaviour such as, for example, the decision-making process. Further, the use of counterfactuals may shed light on human behaviour in the past by considering situations that did not actually occur. Both Baker (1976) and Prince (1978) have suggested that counterfactual methods might be profitably used to assess the results of particular processes.

The use of counterfactuals is associated with new economic history. Theoretical models that are based on a limited number of variables are used to further explanation by employing quantitative techniques to test hypotheses derived from theory. Counterfactual assertions have been used in studies made in new economic history to assess the effects of specific variables on economic development. This has been achieved by analysing the consequences of the removal of the causal variable and considering the consequences of hypothetical alternatives. Both Fogel (1964) and Fishlow (1965), for example, removed the American railway system, in their studies of 1890 and 1859, respectively, in order to test hypotheses concerning the effect of railways on American economic growth. Their results suggested that the railway system made only a minimal contribution to the Gross National Product.

In order to assess and explain the consequence of a particular process and the way people act, it is necessary to consider the consequences of hypothetical alternatives to reality. To say "the thing happened the way it did, is not at all illuminating. We can understand the significance of what did happen only if we contrast it with what might have happened" (M. R. Cohen, quoted in Fogel, 1964, p. 17). The hypo-

thetical alternative or counterfactual should be a feasible one. Three uses of counterfactuals in historical geography have been suggested (Norton, 1979). The first use is to test hypotheses which associate an event, which did not actually take place, to a related result. In this case the counterfactual event is a feasible alternative to the actual event and there is reason to expect the occurrence of the result. The second purpose of testing a counterfactual assertion is to establish whether or not the result would have occurred without a specified assumed causal event. This indicates that it is possible that the outcome occurs regardless of the assumed cause. A third use of a counterfactual approach may be to consider alternative decisions made in the decision-making process, together with their subsequent results. Counterfactuals may be used, therefore, to emphasise the importance or question the assumed importance of specific variables in a process.

Little explicit use has been made of counterfactuals in historical geography. One study in which a counterfactual approach was adopted is that by Norton (1978) where the approach was used to establish the consequence of the removal of a variable from the frontier settlement process. A constraint was built into the process generating settlement forms for nineteenth-century southern Ontario, namely that at any one time not all of the townships in the study area were available for settlement due to government policy restricting settlement to already-surveyed townships. In order to observe the spatial consequences of a counterfactual settlement process, forms were generated with the constraint removed, producing different forms. The use of the counterfactual indicated the relevance of the constraint to both settlement evolution and the observed form.

(e) Summary

Several developments in historical geography may be recognised as follows. First, the development from a static to a dynamic approach, of which a process-form approach is an example. Second, studies have developed from a general to a more specific and analytical nature. The third development involves the use of quantitative techniques, simulation and counterfactuals to make studies increasingly explanatory rather than emphasising description. This is, in part, the result of the fourth development which is a developing tendency from empirical to more theoretical approaches. It appears that a study of spatial form evolution reflects these developments. Such a study may thus usefully employ a process-form reasoning, operationalised by simulation and incorporating counterfactual arguments.

This study is an analysis of spatial form evolution that uses a modified process-form procedure. A settlement process is formulated and, although settlement forms are not derived from it due to the complexity of implementing this procedure, settlement forms are analysed to determine whether or not the settlement process, comprising variables derived from theory and empirical studies, may have generated the real-world forms. Analysis includes the use of stepwise multiple regression which is a more commonly-used technique than simulation. A simple counterfactual is used to illustrate the importance of one of the variables in the settlement process. Hypotheses, which are both theoretically and empirically derived, are tested to determine the effects of the variables on the date of settlement.

2. Settlement Geography

The extent of settlement theory development is limited. Only a few settlement theories exist which attempt to isolate the properties of settlement diffusion (Bylund, 1960; Christaller, 1966; Hudson, 1969; Vance, 1970) and there is no one theory of settlement accounting for the evolution of both rural and urban settlement for existing settlement theories have either a rural or urban emphasis. It is clearly unrealistic to consider the evolution of rural and urban settlements as occurring independent of each other. Instead of being viewed in isolation, the evolution of both rural and urban settlements should be regarded as components of a wider system of economic development of the landscape, thereby recognising the complex nature of the study of settlement evolution.

(a) Rural Settlement Theory

It is likely that the diversity of rural and urban settlement evolution has prevented the formulation of a united settlement theory comprising both components. A presentation of the two main theories of rural settlement provides the background for the study of agricultural settlement evolution. These concepts, proposed by Bylund (1960) and Hudson (1969), are considered in order to identify their approaches to the study of settlement and the variables considered to have been of importance in settlement location.

Bylund (1960) discussed the expansion of rural settlement in inner North Sweden with reference to an initial four models of settlement development and he subsequently proposed a fifth model, the E-model, which incorporated simple complicating factors based on empiri-

cal observation into the D-model. He used an inductive-deterministic approach to the formulation of his models which were inferred from empirical observations, rather than derived from theory. Bylund's earlier empirical findings concerning the colonisation process in Lappland formed the basis for his claim that the spread of settlement is determined by a set of attraction values of the land. He inferred a settlement process from a comparison of the models with the observed settlement form, arguing that the closer the model accorded with the observed form, the greater the feasibility of the model as a simplification of the real-world settlement process. Bylund (1960) concluded that measures of distance and the environment are the dominant variables determining the spread of settlement.

Rather than analyse form alone, Hudson (1969) adopted a process-form oriented approach to explain changes in settlement distribution through time. His deductive theory of settlement diffusion is based upon four sources of location theory, namely, central place theory with its emphasis on form, diffusion theory with its emphasis on process, ecological distribution theory and morphological laws. Hudson (1969) postulated three processes for rural settlement, similar to those found in plant ecology, which are based on distance and environmental considerations. Employing the terminology introduced by Hudson, the three processes considered to be operating are colonisation, spread, and competition, where initial colonisation refers to the in-movement of people to a previously unoccupied area. This phase is followed by a period of settlement spread, when movement within the area takes place, and is ultimately followed by competition for land as the density of settlement becomes too great. The associated patterns of settlement

resulting from these processes, settlement forms, are respectively random, clustered and regular (Hudson, 1969). The more usual evolution of form, however, has been thought to be from clustered to random and, subsequently, to regular distributions. Grossman (1971) made some valid criticisms of Hudson's (1969) work, contending that Hudson failed to derive general "laws" of settlement because his theory was derived from ecology and suggesting that in most cases these principles are inappropriate to human behaviour. Grossman (1971) further argued that, unlike vegetation growth, there is relatively little free competition, due to imposed institutional constraints. Grossman (1971) did not find a random settlement pattern to be a common occurrence since human settlement patterns are frequently planned. These arguments were based upon empirical work in Iboland, Nigeria, where the individual had little freedom of choice in selecting his settlement location. In this area the settlement pattern was modified by the government. It was deliberately planned, not random, with settlers locating on the frontier to prevent neighbours from encroaching. This indicates a high degree of competition at an early stage in the settlement process, which is at variance with Hudson's (1969) empirical observations in Iowa, where competition between locations was not manifest until the final stage in the settlement process.

Both Bylund (1960) and Hudson (1969) have focused more on the spatial derivatives of rural settlement diffusion than on the underlying sociological and economic factors. This is a disadvantage of their theories since some behaviouristic considerations would have added insight into the settlement process. The need for an evolutionary approach in contrast with a static method of analysis once again indi-

cates the value of adopting a process-form analysis of settlement.

(b) Previous Settlement Studies

This section presents some examples of empirical rural settlement studies, excluding those relating to the prairie region which are examined in Chapter III. This section has three aims. First, the approach used in the studies is identified. This may be either a descriptive account, an empirical testing of theory, or a combination of the two approaches. In addition, the account may be of a static or dynamic nature. Second, the scale of the study area analysed is noted. Third, the variables that have been considered to be of importance in the location of settlement are identified.

Hudson (1969) proposed his theory of rural settlement over a decade ago yet, although a variety of descriptive and more quantitative analytical approaches to the study of settlement have been made, there has been little empirical testing of his theory. The use of theory has been limited in the study of rural settlement. Instead, the approach has been mainly descriptive, focusing upon certain variables that have been thought to be important in the settlement of specific regions. Institutional, behavioural and economic factors have thus been identified as being important criteria in the evolution of rural settlement, in addition to the environmental influences and various measures of distance that have been identified as being the principal variables in the rural settlement theories.

Until the 1960s settlement studies characteristically focused upon a discussion of settlement types. These studies described the degree of nucleation or dispersion of settlements with reference to

environmental, distance and social variables, frequently focusing upon the influence of culture on the landscape. Demangeon (1962), for example, classified settlement forms by studying the influences that determined them. He found that the natural and social conditions, together with the influence of the agricultural economy, determined settlement type. The physical environment, ethnic traditions and the technological level of the agricultural system were thus found to influence the degree of nucleation or dispersion. In an earlier study of rural settlement types, Ahmad (1952) found that his four types of settlement were correlated with the physical and cultural environment. Following an analysis of maps, Ahmad (1952) suggested that the factors that contributed to the agglomeration of rural settlements in the Uttar Pradesh, India, were uniformity of relief and soil fertility, as well as those relating to cooperation in agricultural activity and clan solidarity. Fragmentation was proposed as being a result of an abundance of surface water, low agricultural productivity and caste hierarchy. An example of a study of rural settlement types in North America is that by Trewartha (1962). Based on research into the types of rural settlement of colonial America, Trewartha concluded that, in addition to the physical environment, cultural conditions determined the observed differences between the settlement types of New England, the middle Atlantic and southern regions. Another descriptive analysis of nucleated and dispersed settlement is that by Dickinson (1949) who argued that variations in settlement form in Germany were due to the interplay of the physical conditions and the social and economic history of the area.

Camm (1967) and Rice (1978) both drew attention to the importance of institutional influences on settlement. Camm (1967), dealing

more with the evolution of land use than with the evolution of rural settlement, considered the influence of colonial and state governments to the question of land tenure and the way state-aided projects to settlement led to the development of the rural landscape in Jimbour, Queensland. Rice (1978), likewise, described the way in which the federal government's land alienation policies and practices influenced the order in which settlers took up particular parcels of land in central Minnesota in the late nineteenth century. This indicates that the settlement process might be seen as a competition by settlers for different kinds of land, where settlers did not have complete freedom in their choice of location.

Considerable importance has been placed on the part played by human behaviour in the settlement of an area. Both Jakle (1974) and Johnson (1974) drew attention to man's perceptions of the world in the settling of the upper Midwest. Powell (1971) claimed the necessity to consider the complexity of man's decision-making process, believing it to be necessary to consider the ideas, ideals and institutions of society as a whole. He advocated a phenomenological approach to the study of settlement, but made no reference to actual settlement processes or patterns. Similarly, Harris, Roulston and De Freitas (1975) suggested that a dominant ideology shaped the settlement of Mono township, sixty miles northwest of Toronto.

In a description of rural settlement patterns in the San Luis Valley, Colorado, Carlson (1967) identified the way in which distinct groups of agricultural people settled in a different manner within an area of similar natural conditions. He showed how the settlers used their land, but did not employ descriptive statistics to outline when,

where and how their settlements evolved, which seems essential if a theory is to be tested.

Unlike these studies which focus upon single variables in the settlement process, Smailes and Molyneux (1965) identified economic changes, technological progress and accessibility as being important in determining stability of settlement in southern New England, New South Wales. They found that a thinly scattered network of pastoral stations was rapidly established in the 1830s and that this network was selectively filled in by settlements associated with agriculture as well as small urban centres. Although weakly formulated, this study presented an evolutionary approach to the study of settlement.

Only a limited number of explicitly quantitative approaches have been made in rural settlement studies to aid the explanation of settlement evolution. One means of analysing the expansion of settlement across a region over time is trend surface analysis. This technique, which is concerned with the smoothing of settlement surfaces in order to uncover the underlying trends, separates population surfaces into regional and local components. It is a useful way of analysing changing settlement forms which is integral to the study of settlement evolution. Florin (1977) used trend surface analysis to quantitatively describe the advance of the settlement frontier across Pennsylvania which began in the first half of the seventeenth century. This method of analysis was also used by Clarke (1972) and Norton and Smit (1977) to analyse the spatial pattern of population density in southwestern Ontario and Cape Province, South Africa, respectively. Results of the South African study revealed that the principal variables influencing the progress of rural settlement were measures of distance, environmen-

tal and institutional factors.

In addition to trend surface analysis, use has been made of regression and simulation techniques in the analysis of settlement patterns. Conzen (1971), for example, developed a model of land acquisition for Blooming Grove township, Wisconsin, and tested this model using multiple regression analysis. The model, which was designed to "predict" the date of land sales, incorporated distance, environmental and institutional variables. Work by Norton (1976) in southern Ontario demonstrated the use of simulation in the study of agricultural settlement evolution. Simulation techniques permit the relationship between process and form to be investigated. Although simulation has not been widely adopted in settlement studies, it has proven to be a profitable method of operationalising process-form reasoning which is desirable to the study of settlement evolution.

The variety of approaches to the study of settlement is apparent. It appears that little distinct testing of theory has been attempted. Instead, a number of descriptive approaches dealing with the settlement of particular areas, focusing upon individual variables, have been made. These approaches have not been conducive to the formulation of a generally applicable theory of rural settlement evolution. They have focused insufficiently on the application of simple quantitative techniques to aid the explanation of settlement evolution. These descriptive studies have revealed the large number of factors influencing settlement location which, since they are largely location-specific, cannot be incorporated into a generally applicable settlement theory or process. Nonetheless, the formulation of a process appropriate to the area being studied is of principal concern if the settlement evolution of that area is to be explained.

CHAPTER III

THE STUDY AREA

This chapter provides the background to the settlement study and is divided into five sections as follows. First, the study area is delimited within the prairie-parkland region. Second, the sampling method used to select the quarter sections analysed is identified. Third, the data collection procedure is outlined. Fourth, the physical and economic background to the settlement of the study area is presented. Fifth, a selection of previous settlement studies of the Canadian prairies is reviewed in order to demonstrate the various approaches adopted, the scale of the analyses and the factors assumed to have been influential in the settlement of the West.

1. Delimitation of the Study Area

In 1872, two years after Manitoba joined Confederation, approximately one-third of the study area was within the province of Manitoba. Successive boundary changes in 1877 and 1881 resulted in increases in the size of the province and Figure 1 illustrates the stages by which the study area, comprising Townships 7 to 14, Ranges 10 to 16, west of the Principal Meridian, gradually became wholly within the province of Manitoba, having previously been in part within the North-West Territories. The study area is both a part of the province of Manitoba and a

part of the prairie-parkland physical region (Kaye and Moodie, 1973). This region, which comprises grasslands with scattered clumps of trees, extends from southern Manitoba to present-day southern Alberta.

2. Sample

The study area was divided into fifty-six townships using the rectangular survey system. Each township contains 144 quarter sections and thus the study area consists of 8064 quarter sections. Since it is not feasible to analyse every quarter section in the study area, a subset of 1000 quarter sections, forming 12.4 percent of the quarter sections in the study area, is selected for analysis. In order to be unbiased and representative of the entire set of quarter sections, the sample needs to be drawn from the population randomly, such that each quarter section in the study area has an equal chance of being included in the sample. The sampling method should ensure an adequate coverage of the total population. The selection of one quarter section makes no difference to the probability of another quarter section being selected or not selected.

Random sampling involves the random selection of observations from the total data set. Three methods of random sampling are the basic random, the systematic random and the stratified random methods. Using the basic method all observations are randomly selected. Using the systematic method only the initial observation is chosen at random and subsequent observations are picked at a regular interval. This method should not be used where there is a periodic repetition of conditions at the same interval as the sample interval. Using a stratified random sample the population is divided into strata and either each stratum is

sampled or a variable sampling procedure is employed (Berry and Baker, 1968). A variable sampling procedure determines the number of observations to be selected from each stratum proportionate to its size in relation to the total population.

Each quarter section in a township was either Dominion land or allocated to a particular grant type. In every township all quarters of sections 11 and 29 were assigned as school land. Similarly, specific quarter sections in each township were allotted to the Hudson's Bay Company, namely the four quarters of section 8 and three quarters of section 26. In addition to section 8, all four quarters of section 26 were allotted to the Company in every fifth township. The remaining quarter sections in a township were of a variety of grant types. A systematic random sampling method is not used in this study since quarter sections of specific grant types occur at regular intervals in each township of the study area. Neither is a stratified random sampling method used, where a stratum is equated with a grant type, because it has been found that the grant type of a quarter section did not influence the settler in his location decision-making process other than in terms of the cost of its acquisition (Loveridge, 1977). Instead, a basic random method is used to select the sample of 1000 quarter sections. The sample observations are drawn using Fisher and Yates' (1948) table of random numbers. Their selection comprises two stages. First, 1000 sections are randomly selected; second, one quarter section is selected at random in each of the 1000 sections. This method of random sampling permits the selection of only one quarter section per section.

3. Data

The purpose of this section is to outline the data collection procedure, indicating the nature of the data collected, their sources and the assumptions made in the course of data collection. Analysis of first agricultural settlement is made at the scale of the quarter section. Although this is usually taken to mean a square area of 160 acres, quarter sections were frequently between approximately 150 and 170 acres due to both inaccuracies of the survey and the convergence and divergence of meridians. Sometimes the quarter section was further subdivided into legal subdivisions, or fractions of legal subdivisions. There are several such parcels of land in the random sample selected. Where a selected quarter section is subdivided, the subdivision which was settled first is the one analysed. For convenience, each parcel of land analysed is referred to as a quarter section.

(a) Principal Data Sources

Data relating to the emergence of the economic landscape are obtained from two principal sources, township general registers and township diagrams. Township general registers held at the Crown Lands Branch of the Department of Mines and Natural Resources, Winnipeg, provide much information about the original disposition of Crown lands and subsequent disposal of these lands. The term "disposition" refers to the manner in which the Dominion allocated lands to different grants. "Disposal" means the transfer of land from the Dominion, and the corporate bodies receiving grants from the Dominion, to private ownership (Tyman, 1972). Details about the survey and environmental information of the quarter sections are found on township diagrams and in surveyors'

note books at the Surveys Branch of the Department of Mines and Natural Resources, Winnipeg. A township diagram, based on surveyors' field notes, is a map of the surveyed township illustrating the acreage of the sections and environmental information relating to the township, in addition to pre-survey settlement, where applicable.

(b) Year of Entry of Quarter Sections

The study assumes that all settlers are agriculturally-oriented. An agricultural settler is defined as a commercially-oriented individual who has filed an application for homestead entry or has bought an entire quarter section or part thereof. Information relating to the year in which a specific quarter section is entered is collected from different sources, depending on the grant type of the quarter section. Although township general registers note the grant type of each quarter section, details of the year of entry are provided only for the following grant types in the study sample; homestead, Dominion lands sale, school land, military homestead, military bounty, North West Mounted Police Force, Manitoba University and special grants, in addition to wood lots. Information regarding the years in which Canadian Pacific Railway lands were sold are located in the Canadian Pacific Railway land sales records at the Archives of the Glenbow-Alberta Institute in Calgary, and the dates of sale of Hudson's Bay Company lands are noted in the abstract books of the appropriate Land Titles' Offices. Where the Canadian Pacific Railway land sales records indicate a larger number of quarter sections as being Canadian Pacific Railway land than are noted in the township general registers, the earlier year of entry of the two cases is assumed to be the date of entry and the land grant associated with the earlier date

is noted. The date of entry is assumed to refer to the first settlement of a quarter section. This may, however, not have been the case since the township general registers record only the date of entry that resulted in the issue of a patent. Earlier entries, which were subsequently cancelled, are thereby ignored, as is pre-survey settlement by squatters. In some instances the Canadian Pacific Railway land sales records reveal two dates of entry for the same quarter section. In order to be consistent with the way in which information on dates of entry is collected from the township general registers, the second date of entry is regarded as the year of settlement, thereby assuming that the first entry was cancelled. Details regarding the years in which Canadian Pacific Railway, Hudson's Bay Company and school lands became available for settlement are obtained from material held at the Archives of the Glenbow-Alberta Institute, township general registers, and Privy Council Orders, respectively. A quarter section was open to settlement following the approval of the survey of the township in which that quarter section was located by the Surveyor General in Ottawa. This study assumes land was available at any time in the year in which its survey was approved, subject to certain grant-specific conditions, regardless of the month in which approval occurred. Similarly, the year of entry refers to the year in which land was settled, irrespective of the month of entry in that year.

(c) Environmental and Distance Information Relating to Quarter Sections

In addition to details relating to the disposition and disposal of each quarter section, measures of the environment and distance are taken for each parcel of land analysed. Township diagrams and survey-

ors' field notes provide the source for most of the required environmental information. The presence or absence of flowing surface water and woodland in the quarter section is recorded from these documents. Where possible, data provided by the field notes are used in preference to those illustrated on the township diagram, since the diagrams were usually derived from information recorded in the surveyors' notes. The use of these data requires several qualifications. Since surveys were carried out along the boundaries of quarter sections, only the presence of water or woodland along or visible from these lines was recorded, so that there is little indication as to their possible presence in the interior of quarter sections. Further, the notation of woodland on the township diagrams does not distinguish between wood or scrub. These sources do not provide a reliable source of information on environmental features. Surveyors' notes provide an inconsistent and frequently inaccurate source of information since no standard, systematic means of notation was required of the surveyor. It is therefore possible that the presence of a particular vegetation or soil type was not recorded. Qualitative comments concerning the suitability of the township for agricultural and settlement purposes found in the field survey reports accompanying the field notes provide contemporary ideas about what qualities were regarded as conducive to settlement. Since contemporary data relating to nineteenth-century land quality are not available, a present-day source is used in order to calculate a land quality value for each quarter section. The Canada Land Inventory classification of soil capability for agriculture recognises seven classes of land capability, in addition to an eighth class which is not placed in the capability rating. For the purpose of this study eight classes are recog-

nised and assigned values ranging from eight for the best land (class 1, Canada Land Inventory) to one for the poorest land (class 0, Canada Land Inventory). An estimated percentage of the amount of land in each soil capability class is made for each quarter section, using the appropriate map sheets of the Canada Land Inventory. The land quality value for each quarter section is obtained by multiplying the percentage in each class by the corresponding value and summing the eight products.

Since the actual location of the homestead is unknown, straight-line distance measures are taken from the centre of the quarter section. Distances are calculated to Winnipeg--the entry point for immigrants intending to settle in the area of Manitoba studied, the nearest service centre and the nearest trail. Following the construction of railway lines, distances are measured to the nearest railway loading point also. Information concerning the exact location of centres and the year in which they are known to have been in existence are obtained from several sources. Railway plans held at the Surveys Branch and town plans at the Land Titles' Offices illustrate the actual location of centres by quarter section. In addition, information regarding their known year of existence is taken from censuses, secondary sources, Henderson's directories and nineteenth-century maps held at the Provincial Archives of Manitoba. The year in which a centre is first mentioned to have been in existence is used in this study (Figure 2). A drawback to this assumption is that the service centre may have been formed at an earlier date. No information about the population size of the centres is collected. All service centres are assumed to provide basic functions and all railway settlements are assumed to provide a boarding and disembarking point for settlers, in addition to some form of loading

facility for agricultural produce. Details relating to the location and construction of elevators established during the period analysed are noted from Henderson's directories, secondary sources and contemporary maps. These same maps further provide information regarding the location of trails at the scale of the quarter section. Surveyors' township diagrams and contemporary maps provide details about the location of trails and a plan of the exact location of the Fort Ellice trail is used. Due to the nature of the source material, only the general locations of the trails are known. Where even the general locations are unknown, the directions of the trails are estimated (Figure 2). No information regarding the location of roads is collected since trails were in use until railway lines were constructed (Friesen, 1963-64). Finally, the exact location and construction histories of the Canadian Pacific Railway Company, the Manitoba and North Western Railway Company and the Manitoba South Western Colonization Railway lines established in the study period are obtained from railway plans and documents provided by the Surveys Branch, the Canadian Pacific Archives and the Public Archives of Canada as well as from secondary sources.

4. Background to the Settlement of the Study Area

(a) Physical Environment

The study area consists of grasslands with scattered clumps of trees which form a transition between the grasslands to the south and the boreal forest to the north. Watts (1960) identified this area as part of the aspen-oak grove, or parkland, of the Canadian West. In the northern half of the area analysed the dominant natural vegetation is wooded grassland. There is a transition in the ratio between grass-

land and trees from east to west. Grassland becomes increasingly dominant towards the west and there is a corresponding decline in the number of trees. In the east trees are ubiquitous but in the west they are found mainly in scattered groves, specifically comprising aspen and willow. Mixed stands of spruce and aspen are associated with the drier sites in the southern half of the study area, south of Carberry in Spruce Woods Forest Reserve (Figure 2). This lies west of the broad-leaf forest where aspen and willow predominate with elm, ash and burr oak. Spruce Woods Forest Reserve occupies 223.5 square miles of the study area (Figure 2) and was Dominion land closed to settlement during the period analysed.

Approximately 82 percent of the soils in the sample analysed are considered capable of sustained use for cultivated field crops such as wheat (Canada Land Inventory, 1966). The remaining 18 percent are considered suitable for the cultivation of perennial forage crops. Thus all land in the study sample could be cultivated to some degree.

Two major rivers in southern Manitoba are the Whitemud and Assiniboine Rivers. These are the principal rivers in the area analysed (Figure 2).

(b) Survey and Land-Granting System

The survey was a prerequisite for legal occupation of the land. Two types of survey were made in Manitoba, namely, the river long lot system which was modelled after the survey used in Lower Canada and the sectional system of survey which was a variant of the system used in the United States. Three versions of the latter system were developed for western Canada and the study area was surveyed using only the First

System. This version was approved in 1871 when the township was divided into thirty-six sections of 640 acres each. The section, being one square mile, was further divided into four quarters which in turn were subdivided into legal subdivisions of forty acres. In between the sections land was reserved for the construction of roads; under the First System these road allowances were 99-feet (1.5 chains) wide. The survey of the study area took place between 1871 and 1889. All quarter sections settled by 1891 had been surveyed by 1879. Of these, 52.9 percent were surveyed in one year, 1873, and by the end of 1874 81.6 percent of the quarter sections analysed had been surveyed (Figure 3).

Under the terms of the Manitoba Act of 1870 all lands that were ungranted or considered waste lands in Manitoba and the North-West Territories were to be administered by the government of Canada. There were two major objectives in the administration of these Dominion lands. One was to build a Pacific railway and the other was to promote rapid settlement in the West by means of a free homestead system. The way in which the Dominion lands were disposed of in order to achieve these objectives were closely interrelated. In return for surrendering control of the land to the Crown, the Hudson's Bay Company was entitled to £300,000 in cash and blocks of land around its trading posts, in addition to one-twentieth of the land in the fertile belt. The fertile belt coincided with the parkland and adjacent tall grass prairie (Kaye and Moodie, 1973) and the land reserved for the Company was within an area bounded by Lake of the Woods in the east, the Rocky Mountains in the west and was south of the northern branch of the Saskatchewan River in Canada. These terms were implemented in the Dominion Lands Act of 1872 when seven quarter sections in each township were allotted to the

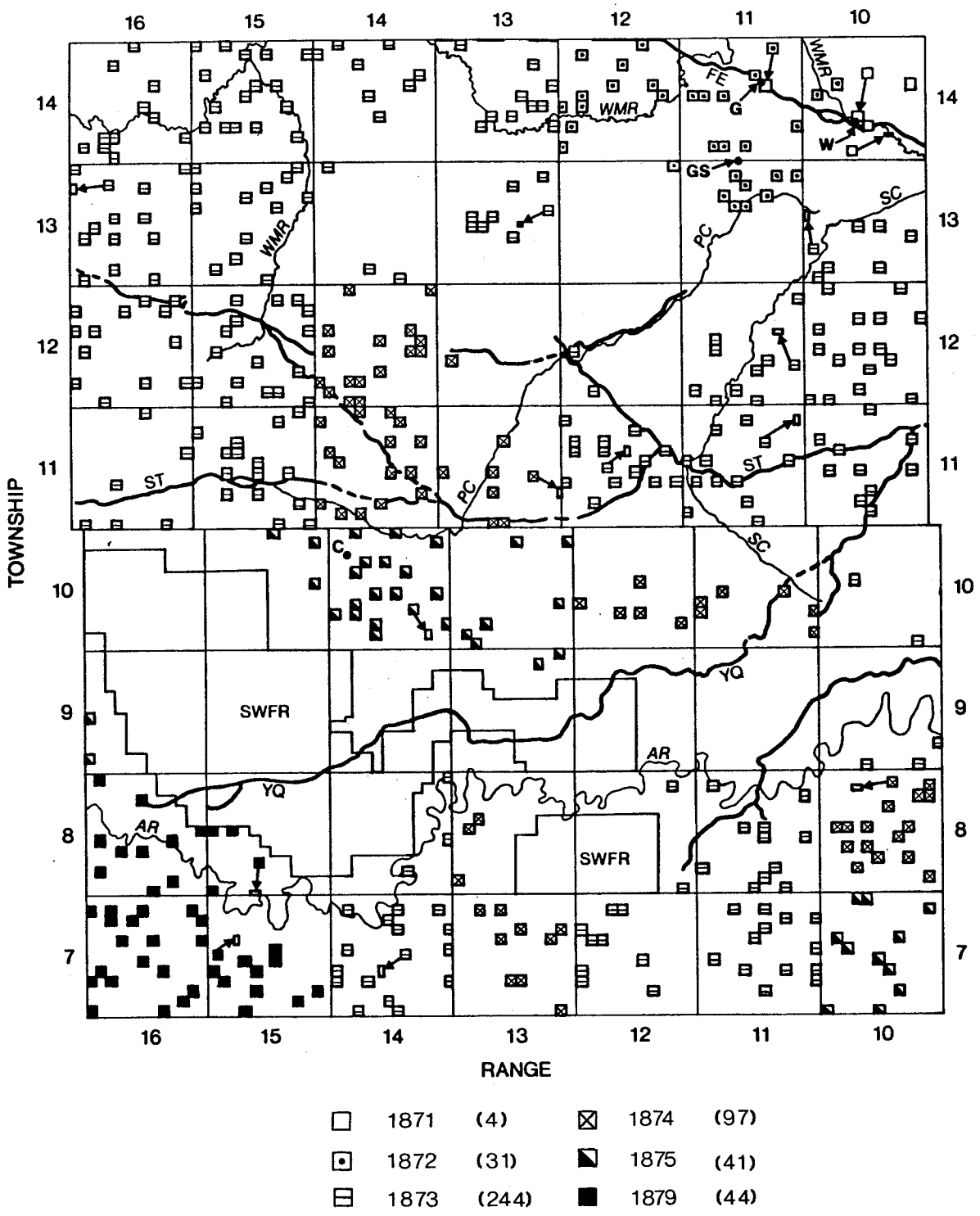


Figure 3. Date of Survey, 1871-1879

Company, four in section 8 and three in section 26, except for every fifth township (that is, townships 5, 10, 15, etc.) where all four quarters of section 26 were assigned. These were not made available for sale until 1879. As Loveridge (1977) noted, the Hudson's Bay Company land grant differed from other grants allocated under the Dominion lands policy in that lands awarded to the Company were a payment for services rendered, whereas other grants were intended to facilitate settlement.

The free homestead was introduced in 1872 as a means of disposal to promote settlement. Free homesteads were not actually "free". Certain "duties", which were periodically revised, were required of homesteaders, involving residence and cultivation requirements. In 1872 any person who was either the head of a family or at least twenty-one years of age was entitled to enter for a quarter section of 160 acres. Following the payment of an entry fee of $10.00 the entrant was required to live on his quarter section for at least six months of each of three consecutive years while making improvements to the land. Only after a minimum of three years, all conditions having been met, could the applicant receive the patent to the land. In actual fact, the period between date of entry and date of patent being granted was frequently considerably longer than this. Originally, a settler could homestead any Dominion land that had not been assigned as Hudson's Bay Company land or designated as school land under the terms of the Dominion Lands Act of 1872, regardless of whether the quarter section was part of an odd- or even-numbered section. Sections 11 and 29 in each township were administered by the Dominion for educational purposes. Any revenue obtained as a result of sale or rent of school land was to be used for

the purpose of education. School lands were reserved from sale until the area was well-settled so that an optimum price might be received for the land. Sale of such land was by public auction which, in the study area, commenced in 1888, except for one sale in 1883.

The idea of using land to build the transcontinental railway was contained in the Pacific Railway Act of 1872 but it was not until 1879 that the means of building the line was investigated. Five parallel belts of land were drawn up along the railway line, with the price of railway land decreasing with distance from the railway, ranging from $6.00 per acre within five miles of the line to $1.00 per acre at a distance of 110 miles. Alterations to these prices of July, 1879, made in October, 1879, were subsequently discarded when, in 1881, the government decided to return the project of railway construction to a private company. In the charter of the Canadian Pacific Railway Company the Company was granted the odd-numbered sections within a forty-eight mile belt along the actual railway line and, where the Company did not consider the land suitable for settlement it could select alternative sections. In 1882 the even-numbered sections within one mile of the main line were withdrawn from homestead entry. The reason for reserving this one-mile belt from entry was that its value "should accrue to the public and not to enterprising individuals" (W. Pearce, quoted in Tyman, 1972, p. 23), but it was opened to homesteading again in January, 1884.

Unreserved Dominion land sales were a further means by which land in the study area passed rapidly from the Crown to the settler. These were in addition to such grants as those awarded to the North West Mounted Police Force and those disposed of as military homesteads, military bounty, Manitoba University and special grants, and wood lots.

Figure 4 serves to illustrate what the pattern of dispositions might have been like in a hypothetical township in 1881. The many variations of land disposition prevented this pattern from being achieved in reality.

(c) Migration to Manitoba

Migration to western Canada began in the 1870s principally from Ontario, but increasingly from the British Isles, Europe and the United States. In 1872, 1,400 immigrants were reported to have entered Manitoba. By 1891 the number had increased more than ten-fold to 15,180, although it is possible that some of these immigrants ultimately settled in the North-West Territories. During approximately the same period, between 1871 and 1891, Manitoba experienced a six-fold population increase from 25,228 in 1871 to 152,506 in 1891. The location decision-making process of agricultural settlers in the late nineteenth century is likely to have involved the making of a large number of decisions. The initial decision is likely to have related to the selection of a general location for settlement, with subsequent decisions relating to an increasingly specific location. Decisions may have included those relating to the selection of a country in which to locate--Canada or the United States, a general region within that country, a general area in the region selected and, subsequently, a specific location, namely a quarter section, in that area. Additional decisions are likely to have been made relating to the selection of a particular mode of transport to reach the chosen location. Initial information regarding settlement in a particular province of Canada may have been obtained from personal communication with earlier settlers of the area considered,

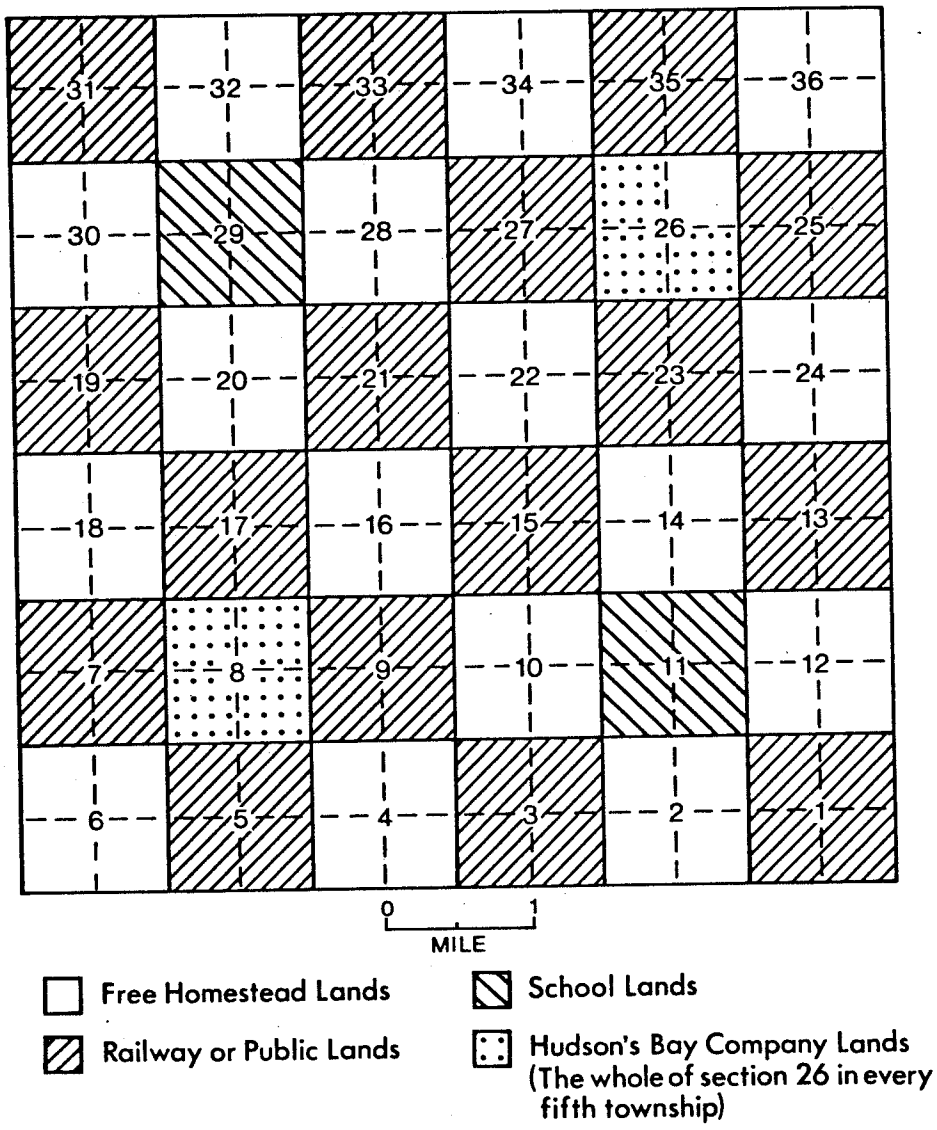


Figure 4. Dispositions in a Hypothetical Township, 1881

literature pertaining to the region or communication with immigration and colonisation agencies. Settlers arriving from the United States would have been subjected to American propaganda setting out the virtues of locating on American soil. However, following the completion of the railway line from St. Vincent, opposite Emerson, to St. Boniface in 1878, it is likely that fewer intending immigrants were diverted to settle south of the international border. Registration for land took place either at the main Dominion Lands Office in Winnipeg or at a branch office, depending on the area selected for settlement. Friesen (1963-64) indicated that a prospective homesteader was advised to contact a land guide at the Dominion Lands Office who would help him locate the vacant land and give information regarding its environmental qualities. During 1890, 272 individuals were registered at the Dominion Government Land Guide Service in Winnipeg. Of these, 226 were guided by the ten registered land guides, whereas the remaining 46 claimed to have been guided by friends. Once the prospective settler had arrived in the region of his choice, he had to decide on a satisfactory location, based on a consideration of the existing situation. This included distance considerations, as well as those relating to aspects of land quality, institutional and individual factors. It is not known how many new settlers actually saw their land prior to settlement. The surveyors' reports on the townships surveyed had the objective of "furnishing such details as may enable the prospective emigrant to choose judiciously the locality in which to settle" and to "form an idea of the expectations which he may reasonably entertain" (Department of the Interior, quoted in Tyman, 1972, p. 17). Surveyors reporting on the townships in the study area not only indicated the variations in

the nature of the terrain, details of vegetation and soil type and the presence and quality of water, but also the suitability of the townships for agriculture and settlement. Thus, one surveyor presented a comparison with Ontario (Township 10 Range 10, west of the Principal Meridian) and others suggested the suitability of the soil for raising grain, for example in Township 12 Range 15, west of the Principal Meridian. These reports were published periodically and together with township diagrams were available to prospective settlers. However, the extent to which this information was made available to the general public has been queried (Tyman, 1972).

(d) Degree of Agricultural Commercialisation

Based on analyses made in comparable pioneer economies (Higgs, 1969; Mitchell, 1972; Norton and Conkling, 1974) it is justifiable to argue that the agricultural settler arriving in Manitoba aimed to participate in commercial agricultural activities from the beginning of settlement. It might be expected, however, that in an area experiencing first settlement there will be an initial period of subsistence agriculture. Mitchell (1972) found this to be the case in the Shenandoah Valley of Virginia. Mitchell (1972, p. 475) further proposed that economic development involved a gradual change "from initial subsistence through progressive degrees of commercialization." A study of agricultural land use in an area north of Toronto in the mid-nineteenth century demonstrated that pioneer settlers located outside the area of commercial production indulged in incipient commercial activities (Norton and Conkling, 1974). This is typical of a rapidly expanding economy where settlers aim to eventually enter the commercial economy

as improved communications reduce the isolation of areas more remote from major markets. Similarly, in a study of early settlement in the western prairie region of the United States, Higgs (1969) found that settlement was mostly by people who wished to produce cash crops for export outside the region. Morton (1938) indicated that, even prior to railway construction, Manitoba's agriculture was in part commercially-oriented. The fact that at least some grain was being exported from 1867 onwards (Morton, 1967) indicates that some, if not all, of the early settlers were commercially-oriented farmers, a situation which was presumably enhanced by the arrival of the railway. The railway provided a means of transport for settlers migrating to the region and was also of economic importance in providing a means for shipping the staple out of the region.

(e) Communications

Until the construction of railways movement was along trails. Settlers heading towards the study area from Winnipeg, the main entry point for settlers going to this region, are likely to have followed either the northern branch of the Saskatchewan trail--also known as the Fort Ellice trail, the southern branch of the Saskatchewan trail or the Yellow Quill trail (Figure 2). The first railway line to be constructed across the area was the Canadian Pacific Railway main line which reached Brandon in 1881 (Figure 2). The following information concerning the construction history of the Manitoba and North Western Railway, as it became known in 1883, was obtained from the Canadian Pacific Archives in Montreal. In 1880 the government of Manitoba incorporated the Westbourne and North Western Railway Company to construct a railway line

from a point on the Canadian Pacific Railway main line near Poplar Point in a northwesterly direction, east of Riding Mountain, to the northern or western boundary of the province. In 1882 the name of the company was changed to Portage, Westbourne and North Western Railway Company and at the end of June, 1882, it was reported that fifty miles of the railway had been completed. This would have been from Portage-la-Prairie to a point approximately fifteen miles west of Gladstone (Figure 2). By the following year the railway's name had been changed to Manitoba and North Western Railway Company of Canada and the line had been completed to Minnedosa, west of the study area. In addition, by 1886 rails had been laid to Glenboro by the Manitoba South Western Colonization Railway Company, thus serving the southern townships of the study area (Letourneau, 1974) (Figure 2). The purpose of this line was to populate and develop southern Manitoba and to connect it with the Pembina branch of the Canadian Pacific Railway. From June 1, 1884, this line was leased to the Canadian Pacific Railwav and by 1891 the line had been extended to Menteith, outside the study area, so that by the end of the period analysed the study area was traversed by three major east-west railway lines (Figure 2).

(f) Service Centres

Only four service centres existed in the study area prior to the construction of the railways but, as construction proceeded, settlements emerged at regular intervals along the lines (Figure 2). In addition to providing basic goods and services, most of these soon included grain loading and unloading facilities in the form of flat warehouses or elevators. In 1884 a newspaper report stated that "where

settlements are small and the grain crops as yet inconsiderable a flat warehouse at the nearest station can do the work, but we certainly hold to the principle that as soon as the quantity harvested will admit of it an elevator should be erected at every railway station" (Nor-West Farmer, 1884). The number of elevators that were erected at stations in the study area during the 1880s demonstrates the increasingly commercial consciousness of the agricultural community. By 1891, for example, Austin had seven elevators, Neepawa had four and Cypress River had three.

5. Prairie Settlement Studies

A selection of prairie settlement studies is presented in this section in order to illustrate the diversity of approaches adopted in western Canada pioneer settlement research. Attention is focused, in particular, on the scale of the analyses, the extent to which an explanation of settlement location decisions is attempted and the factors which have influenced the settlement of western Canada.

(a) Scale and Subject Matter

Studies of early agricultural settlement on the Prairies have been at a variety of scales, ranging from a few townships (Dick, 1980; Loveridge, 1977) to the provincial or subprovincial scale (Richtik, 1971; Weir, 1964) and regional scale (Morton, 1938; Norrie, 1975). Explanation of settlement evolution has been largely inferential. Frequently the settlement process has been inferred from observed settlement forms. This has been achieved by relating the change in the patterns to specific variables. Descriptive chronological accounts of

settlement distributions, sometimes employing quantitative measures, have dominated the literature on the agricultural settlement of the Canadian prairies.

In addition to being influenced by exogenous situations, a form resulting from a specific process should be regarded as the outcome of the interaction of variables endogenous to the study area. Endogenous variables are characteristically local, such as specific environmental, accessibility and social variables, whereas exogenous considerations may include institutional constraints and factors relating to the prevailing economic situation and level of agricultural technology. Warkentin (1963-64) examined the interplay of the environment, transportation, immigration policy, agricultural technology and aspirations of the settlers in his study of western Canadian settlement. In his study, Warkentin (1963-64) reconstructed western Canada for one year only, 1886, rather than look at change through time. Nonetheless, Warkentin (1963-64) focused on a variety of variables which were undoubtedly influential in the evolution of settlement forms in the West.

(b) Variables in the Process

Most authors have focused their studies on variables assumed to be determinants in the settler's decision-making process. These variables have been measures of distance, environmental, institutional and individual factors. Work by Morton (1951), for example, has emphasised the significance of site in the settlement of the West.

(i) Institutional and environmental variables

Two institutional constraints in the settlement process are recognised as being the timing of the survey (Weir, 1960-61) and the

land-granting system. Environmental variables which are thought to have influenced the distribution of agricultural settlement are those concerned with the presence of water, the type of vegetation in the quarter section and the quality of the land for agricultural purposes. Weir (1964) asserted that the presence of water for drinking purposes was regarded as high on the list of priorities for the intending settler and that its presence had some effect in guiding settlement in southwestern Manitoba. Based on his research in this area Weir (1964) found that the first homesteads were located along the banks of streams or in the proximity of springs. This accords with similar findings made by Murchie (1936) and Morton (1967). Loveridge (1977), in his study of the nine-township rural municipality of Sifton in southwestern Manitoba, made no reference to water being of considerable importance to the early settlers, although it undoubtedly must have been. Rather, he demonstrated that the first settlers occupied the quarter sections possessing the best quality land for agricultural purposes. Weir (1964) argued that the concept of good agricultural land implied the presence of woodland and water and did not refer to the suitability of the land for grain growing, although he stated that southwestern Manitoba became a cash grain producing area almost immediately upon settlement.

The presence of wood as both a building material and source of fuel was of particular importance to the earliest settlers. Both Richtik (1971) and Weir (1964) found this to be an important consideration in the settler's decision to locate in a particular quarter section and, in a study of the fuels used by North Dakota pioneer settlers, it was found that "any forested area, no matter how small, was of importance to the pioneer settlers" (Hudson, 1978, p. 4). Settlers preferred

a combination of woodland and prairie but by about 1878 they were less concerned to occupy wooded areas (Richtik, 1971). Until this time prairie land had been regarded as unfavourable to settlement because it was timberless. This is in contrast with the results of a study in a comparable period in southeastern Minnesota (Johnson, 1957) which showed that 49.2 percent of first claims made between January 1 and October 29, 1855, were for quarter sections possessing open prairie land in preference to those with oak woodland.

(ii) Measures of distance

Railway construction, the projection of a route or even the rumour of railway construction resulted in settlement of previously unsettled areas as the realised or anticipated accessibility of land resulted. Richtik (1971, p. 287) regarded the construction of the Canadian Pacific Railway as an "institutional" factor affecting settlement, presumably since the idea of its construction was initiated by the government. It provided access to market for agricultural produce. Mackintosh (1934), writing about the early twentieth century, stated that proximity to real and projected railways was of prime importance to the settler and found that settlers tended to follow the railway or locate along projected lines. Loveridge (1977) noted that the rural municipality of Sifton was opened to settlement after the Canadian Pacific Railway main line reached the area in 1881, thereby making the area more attractive for settlement relative to areas without a railway.

Prior to railway construction settlement took place in the vicinity of trails which provided greater accessibility (Friesen, 1963-64; Morton, 1938; Weir, 1964). Morton (1938) argued that these agri-

cultural enterprises were of a subsistence nature since, due to their isolation and long distance from market, commercial wheat farming was not a viable proposition. Loveridge (1977, p. 153), however, suggested the "immediate importance of wheat in the local economy" and by 1876 some wheat was being exported from the province (Morton, 1967). Richtik (1971, p. 123) further stated that in Manitoba "most of the new settlers apparently planned to grow wheat" which indicates the early commercial orientation of the settlers, since wheat cannot be regarded as a subsistence crop. The arrival of the railway removed the adverse influence of distance from market by making transport easier and quicker. Richtik (1971) suggested that distance to Winnipeg was a consideration in the settler's decision-making process. In Sifton distance to supply centres was not regarded as an important factor to be considered (Loveridge, 1977).

(iii) Presence of earlier settlers

According to Richtik (1971), the most important locational factor was the proximity of other settlers, preferably friends and relatives. He suggested that this was a far more important consideration in the settler's locational choice than the environmental qualities of the land. Lands with either open prairie or woodland, Richtik (1971) argued, were found to be much less popular than those with a mixture, but were occupied by settlers who attached more importance to proximity to other settlers than to physical site characteristics. Richtik (1971), however, did not determine the importance of this variable in relation to other variables in the settlement process of Manitoba. Loveridge (1977) also, argued that, in Sifton, the presence of friends

and family was an important locational consideration. It is difficult to demonstrate the validity of this opinion from the limited amount of information available, however, and the danger of inference is apparent. Further, and more significantly, this argument is in marked contrast to another suggestion (Hudson, 1969, p. 370) made relating to pioneer settlement in North America which stated that it would seem "likely that new settlement would be somewhat repelled by the earlier settlement, under conditions of contiguous landholdings of approximately equal size."

(iv) Economic development

Whereas most authors have inferred the significance of specific variables in the settlement process from settlement distributions, some have examined the rate of settlement of the Prairies by relating settlement to influences external to the study area, such as those resulting from economic development. Thus both Stabler (1973) and Norrie (1975; 1979) related settlement to the prevailing level of agricultural technology. Norrie (1975) viewed Canadian settlement as part of the agricultural expansion of North America which could only proceed when dry-farming techniques had developed to make the occupation of the semi-arid lands a feasible proposition. Lehr (1978) criticised Stabler's (1973) and Norrie's (1975) work for assuming agricultural settlers intended entering commercial grain farming, arguing that ethnic groups were not oriented towards this type of enterprise. It is probable, although not explicitly stated, that their analyses focused on individual rather than group settlement.

(c) Methodological Approaches

Although focusing on measures of distance and environmental variables, none of the forementioned studies referred to the rural settlement theories that have been available since 1960. In addition, few studies of prairie settlement have attempted to explain the process of agricultural settlement with the aid of quantitative techniques. They have largely been descriptive accounts. No studies have analysed settlement evolution at the prairie regional scale or a sub-provincial scale using trend surface analysis or simulation. One recent study by Dick (1980), however, did attempt to analyse land acquisition using a quantitative approach. Based on work by Conzen (1971) Dick (1980) used multiple regression analysis in his study of settlement in the Abernethy District of Saskatchewan. Dick (1980) identified the principal variables influencing land selection as follows; soil quality, accessibility to wood and water, and proximity to grain handling facilities and supply centres. The selection of these variables was based on information derived from contemporary literature and more recent secondary sources. Results of the study indicated that approximately 60 percent of the variation among years of entry was explained by variables based on distance to railway and that the other variables explained only minor parts of the remainder of the variability.

Little use has been made of a counterfactual approach to the study of prairie settlement. While not using counterfactuals to explicitly test the importance of variables in the settlement process, Norrie (1979) did make several counterfactual statements in assessing the influence of the national policy on western settlement. Norrie

(1979, p. 65) proposed that the national policy had little impact on the timing of settlement and argued counterfactually that "settlement could not have proceeded any earlier than it did whatever promotional efforts the government might have made. Equally, it would have occurred when it did regardless of the national policy." Norrie (1979) suggested that settlement up to 1895 was limited as a result of the slow diffusion rate of agricultural technological developments. Following the diffusion of dry-farming techniques, however, settlement was rapid. Norrie (1979, p. 73) further suggested that it is easier to understand why the land disposition system may not have "led to a socially efficient allocation of resources" by considering the consequences of a hypothetical alternative that assumed all government land was periodically put up for auction.

Although Tyman (1972) built, what he termed, a model of the prairie settlement process, its formulation is unlike the one proposed in this study. Tyman (1972) argued that, rather than focus on the variety of possible patterns which might have resulted in the real world, it is necessary to focus upon controls and influences on settlement in the pioneer situation, thereby examining actual physical and cultural conditions in order to develop a settlement model. Tyman's model is a static formulation and cannot be operationalised. It is derived from empirical observation and, using the terminology of this study, would be termed a"form" rather than a "process", since it is typically the outcome of some process. Its purpose is to act as a generalisation of settlement in western Manitoba against which real-world patterns might be measured.

Most studies of western Canadian agricultural settlement have been of a descriptive nature, inferring the variables responsible for change in settlement patterns through time by means of static form analysis. The formulation of an appropriate process, however, facilitates the explanation of spatial form change through time thus eliminating the inference problem.

CHAPTER IV

RESULTS OF THE ANALYSIS OF THE AGRICULTURAL SETTLEMENT PROCESS AND FORM

This chapter presents a model of the agricultural settlement process for southern Manitoba between 1872 and 1891, together with the results of the analysis of the process and related settlement forms. An interpretation of the results is presented in Chapter V and the process-model is assessed. This chapter is divided into four sections as follows. First, the settlement process-model is formulated. Second, the method of analysis is outlined. Third, a descriptive analysis is presented. Fourth, a stepwise multiple regression analysis is performed in order to isolate the principal variables and determine their interaction.

1. Formulation of the Process

The decision to locate in a specific quarter section of southern Manitoba was a response to several variables. Specifically, these include accessibility, attractiveness of the land for agriculture, the presence of water and woodland and personal factors. Theoretical considerations and empirical studies have suggested that the selection of a quarter section for settlement was based on the relative attractiveness of the land in terms of these variables. Settlement was subject to

two institutional constraints, namely the timing of the survey and location restrictions imposed by the land-granting system. Since it is assumed that the attractiveness of a quarter section for settlement is a function of specific variables based on measures of distance and the environment, a model of the location process is formulated which incorporates these variables. Date of entry is thus assumed to be a function of seven variables as follows:

Variable 1. A measure of land quality of the quarter section.

Variable 2. A measure of the presence or absence of flowing surface water in the quarter section.

Variable 3. A measure of the presence or absence of woodland in the quarter section.

Variable 4. The distance between the quarter section and the entry point, Winnipeg.

Variable 5. The distance between the quarter section and the nearest service centre.

Variable 6. The distance between the quarter section and the nearest trail.

Variable 7. The distance between the quarter section and the nearest railway loading point.

Conditions in southern Manitoba changed between 1872 and 1891 and, in order to take account of these changes, modifications in the

settlement process are required. This is achieved by dividing the process into four five-year periods and analysing settlement in 1876, 1881, 1886 and 1891. The relative importance of the variables changes through time. Only in the early 1870s was the presence of water and woodland considered essential in the settler's location decision-making process (Richtik, 1971). By 1878 settlers had become less concerned with woodland, showing an increasing tendency to select land possessing both open prairie and woodland (Richtik, 1971). After 1881, however, open prairie without woodland was preferred (Weir, 1964). In order to take account of the changing value placed on the presence of these environmental variables, they are incorporated in the process only until 1881. Similarly, as new service centres emerged and railway lines were constructed, the attractiveness of each quarter section changes. The variables postulated to be operating in each stage of the process are as follows:

1872 to 1876	Variables 1, 2, 3, 4, 5 in 1876, 6.
1877 to 1881	Variables 1, 2, 3, 4, 5 in 1881, 6, 7 in 1881.
1882 to 1886	Variables 1, 4, 5 in 1886, 6, 7 in 1886.
1887 to 1891	Variables 1, 4, 5 in 1891, 6, 7 in 1891.

2. Method of Analysis

The analysis of the agricultural settlement process and of related forms is presented in sections 3 and 4 of this chapter. In section 3 the focus is on the effect of individual variables in order to assess their impact. The 461 quarter sections entered between 1872 and 1891 are analysed using descriptive statistics in order to test the hypotheses incorporated in the model. Verification of a hypothesis in-

dicates that the individual variable being considered may have contributed to the settler's location decision-making process. In section 4 the process is analysed by testing the combined effect of the variables on the date of entry of the 461 quarter sections. Stepwise multiple regression is an appropriate technique for testing the relative importance of the variables in the model. A functional relationship is postulated between the variables incorporated in the settlement process and the date of entry of quarter sections. Using date of entry as the dependent variable, the influence of the independent variables on the variation in the date of entry can be assessed from the regression. Stepwise multiple regression involves the addition of one independent variable at a time, so that at each step a revised regression equation is computed. The first independent variable to be entered into the equation is the one which has the highest simple correlation with the dependent variable. At this stage partial correlation coefficients, r values, are calculated between the date of entry and the independent variables not included in the equation. These indicate the amount of unexplained variation in the dependent variable accounted for by the independent variables not included in the first regression. At the next step the variable with the highest partial r value is entered into the equation and revised partial r values are computed for those independent variables not included in the regression equation which now comprises two independent variables. At each step revised partial r values are obtained and the variable with the highest value is selected for entry as the next independent variable in the equation. This stepwise procedure is continued until all independent variables have been entered into the equation.

3. Descriptive Analysis

(a) Survey of the Study Area

In 1871 the first survey of the study area was begun by surveyors from Ontario. Although the survey was not complete by 1879, the quarter sections analysed had been surveyed by this date (Figure 3). Sections 1 to 21 of Township 13 Range 10, for example, were surveyed in 1873 although the survey of the remainder of the township was not completed until 1889. By the end of 1874, 81.6 percent of the quarter sections analysed had been surveyed.

Settlement of the land was not legally permitted until the survey had been approved by the Surveyor General in Ottawa. Usually approval was granted in the same year as the first survey was completed or in the following year but in some cases, for example, Township 12 Range 13, the survey was only approved after a series of surveys had been made.

(b) Availability and Entry of the Land

Although the approval of the survey made land available for occupation, not all quarter sections were available upon approval since several additional constraints influenced actual settlement. Thus, Hudson's Bay Company and school lands remained closed to settlement until 1879 and 1888, respectively, and Canadian Pacific Railway land similarly could not be purchased until 1881. Occupation by earlier settlers likewise precluded settlement.

The first two settlers arrived in 1872, the first year in which land was open to settlement, and entered the northwest quarter of section 10 Township 14 Range 10 and the northwest quarter of section 22

Township 13 Range 11. By 1876, twelve settlers had located in the area (Figure 5). It might be expected that settlement would have taken place either in the same time-period in which quarter sections were made available or in the next time-period. An examination of Figures 5 and 6 does not support this postulation. Only 461 of the sample 1000 quarter sections were entered between 1872 and 1891, indicating that over 50 percent of the sample quarter sections were entered after 1891. Of the 461 sample units analysed, only 39 (8.5 percent) were entered in the five-year period in which they were made available for settlement and, in fact, 231 (50.1 percent) were entered more than five years after becoming available. Figure 5 does not reveal any pattern of settlement for individual five-year periods or of settlement spread between 1872 and 1891. No location preference in relation to specific landscape or physiographic features is apparent.

Table 1 summarises the number of quarter sections that were available for settlement and entered between 1872 and 1891. Migration to the study area for any one five-year period was greatest between 1877 and 1881, when 160 settlers entered land. Within this same period 1878 was the year in which most farmers, namely fifty-two, arrived (Figure 7). Figure 7 indicates that 1882 was the year in which most settlers in the sample analysed entered land. Eighty-one individuals made land claims in this year.

Since climatic conditions and natural hazards such as pests affect crop production, their variability may have influenced the number of settlers arriving in any one year. Morton (1938) suggested that, in addition to the general commercial depression of 1876, the plague of grasshoppers that destroyed the crops in 1873, 1874 and 1875 formed an

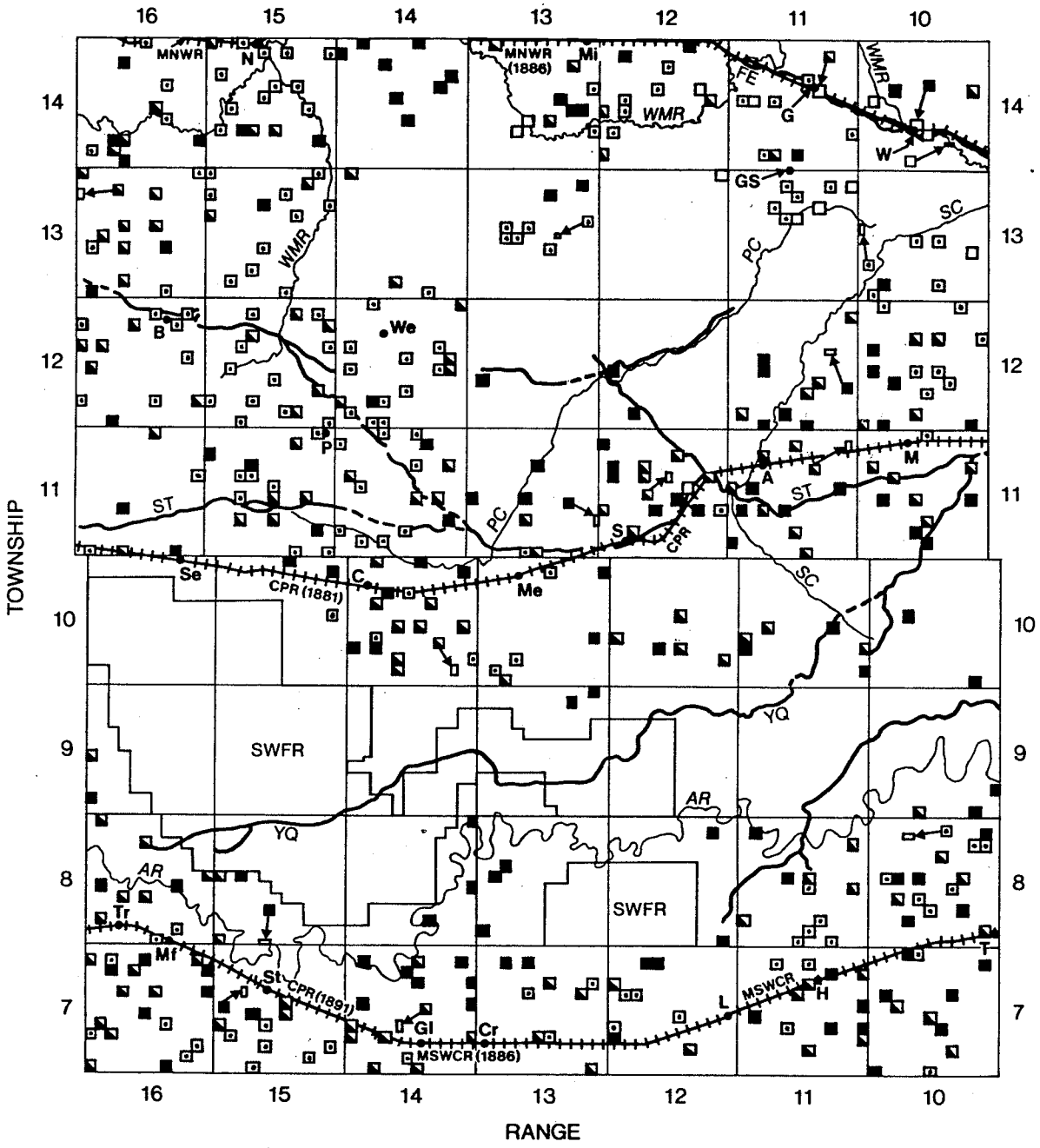


Figure 5. Date of Entry, 1872-1891

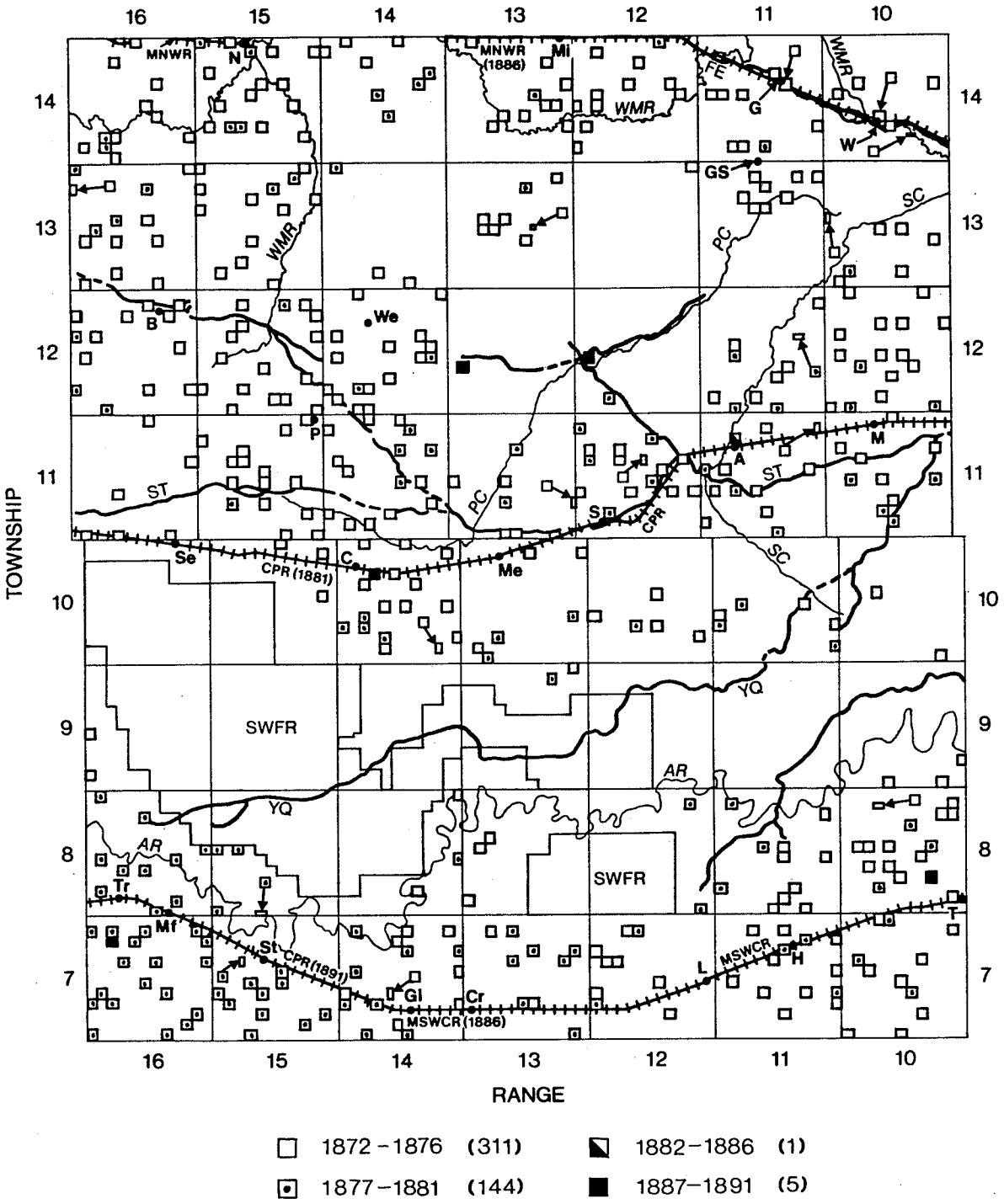


Figure 6. Date of Availability, 1872-1891

TABLE 1

AVAILABILITY AND ENTRY OF QUARTER SECTIONS, 1872-1891

Time Period	Number Made Available for Entry	Percentage of Total	Number Available for Entry	Percentage of Total	Number Entered	Percentage of Total
1872-1876	311	67.5	311	67.5	12	2.6
1877-1881	144	31.2	443	96.1	160	34.7
1882-1886	1	0.2	284	61.6	149	32.3
1887-1891	5	1.1	140	30.4	140	30.4
Total	461	100.0			461	100.0

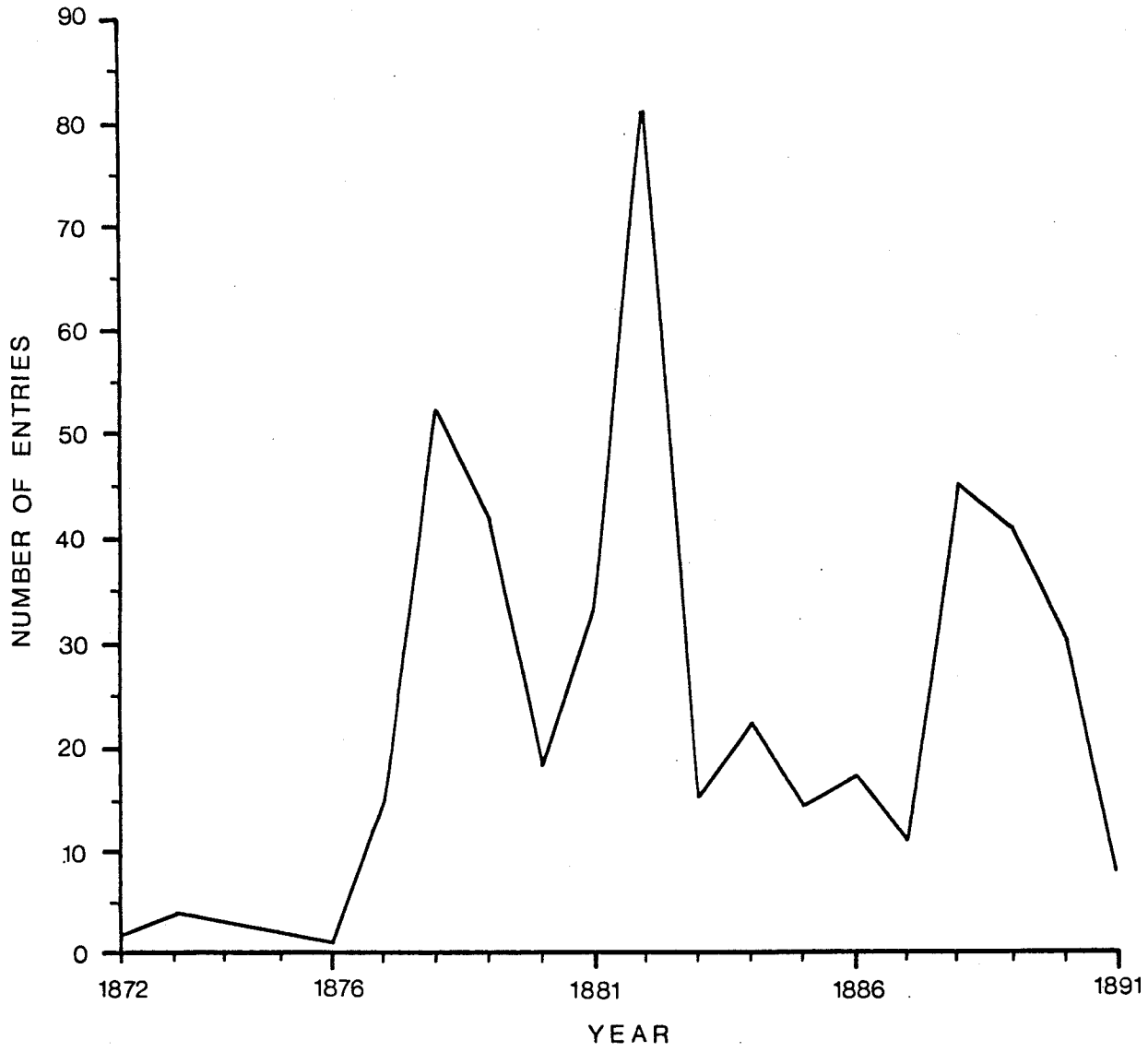


Figure 7. Quarter Sections Entered by Year, 1872-1891

impediment to the settlement of the area in subsequent years. This may suggest a possible cause for the arrival of only six individuals between 1874 and 1876. However, in 1877 alone, fifteen farmers entered land thus indicating a reversal of this trend. No relationship between the number of individuals settling in the area and years of general drought is apparent. The number of settlers entering land in 1884 and 1887, the years following the general droughts of 1883 and 1886, is not markedly different from the number entering in any other years between 1883 and 1887 (Figure 7). Friesen (1963-64) suggested that between 1882 and 1887 movement to Manitoba was limited due to the effects of commercial depression and extreme conditions of frost and drought. This is only borne out in part by the results of this study where the average number of settlers arriving by year between 1883 and 1887 was indeed low, namely sixteen. This contrasts markedly, however, with the eighty-one settlers arriving in 1882, a boom year for settlement in western Manitoba (Tyman, 1972). Between 1882 and 1887, in fact, 160 quarter sections (34.7 percent) were entered in the area. This tendency does not accord with Weir's (1964, p. 65) findings in southwestern Manitoba which indicated that there was a "sudden influx" of settlers between 1880 and 1891.

(c) Testing of the Hypotheses

(i) Settlement in relation to grant type

The 461 quarter sections analysed were assigned to eleven different types of grant (Table 2). Homestead, Dominion sale and Canadian Pacific Railway lands together account for 94.9 percent of the land occupied by 1891. Their distribution in the study area is illustrated

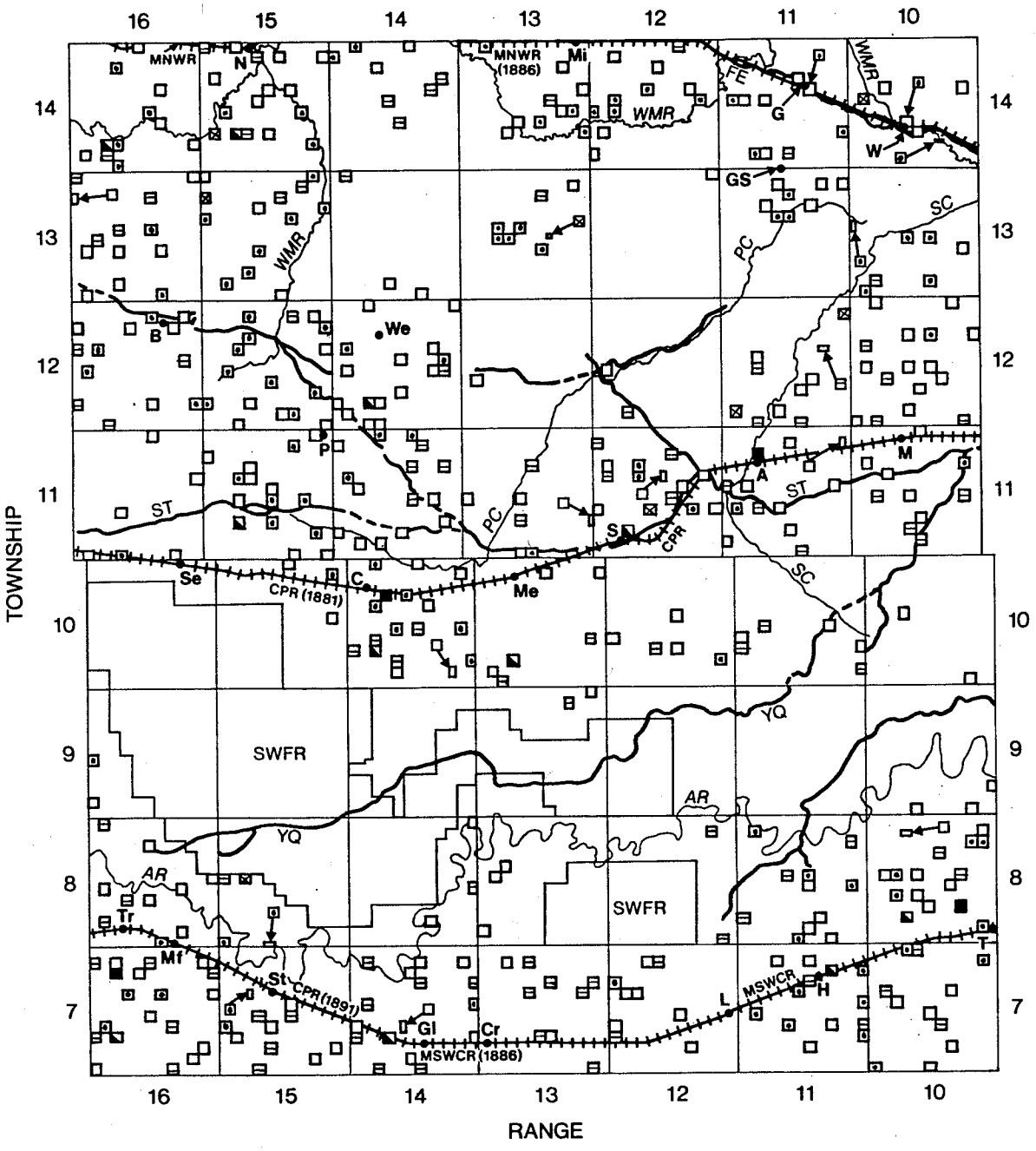
TABLE 2

AVAILABILITY AND ENTRY OF QUARTER SECTIONS BY DISPOSITION, 1872-1891

	1872-76		1877-81		1882-86		1887-91		1872-91	
Disposition	No. A*	No. E**	No. A	No. E	No. A	No. E	No. A	No. E	No. E†	Percentage of Total
Homestead	195	9	205	97	108	54	56	56	216	46.9
Dominion Lands Sale	108	2	114	46	68	48	20	20	116	25.2
Canadian Pacific Railway			105	12	93	40	53	53	105	22.8
Hudson's Bay Company			11	1	10	4	6	6	11	2.4
School Land Sale					1	1	3	3	4	0.9
Military Homestead	2		2		2	2			2	0.4
Military Bounty Grant	1	1							1	0.2
North-West Mounted Police Force	2		2	2					2	0.4
Manitoba University Grant	1		2		2			2	2	0.4
Special Grant	1		1	1					1	0.2
Wood Lot	1		1	1					1	0.2
Total	311	12	443	160	284	149	140	140	461	100.0

* No. A = Number Available; ** No. E = Number Entered; † No. E = No. A.

in Figure 8. The greatest settlement in the area occurred between 1877 and 1881, when 155 of the 424 available quarter sections of these three dispositions were settled. This comprises 35.5 percent of all the land of these three grant types and accounts for 33.6 percent of the total number of entries analysed. This information is presented in Figure 9. The largest number of both homestead and sale entries occurring between 1872 and 1891 was in this same five-year period, namely in 1878, when fifty of these quarter sections were settled. In the following year forty-one individuals made homestead and sale entries, thereby forming the second largest entry for these two grant types in a single year. Mackintosh (1935) found that in the Prairies as a whole the largest number of homestead entries between 1877 and 1881 also occurred in this year, 1879. The occupation of the study area, when analysed with regard to these two grant types, therefore bears close resemblance to conditions prevailing elsewhere in the wider area of the Prairies at this time. The largest number of settlers arriving in the study area in any one year between 1872 and 1891 was in 1882 (Figure 7). Mackintosh (1935) found that most homestead and sale entries in the prairie provinces made during this period were in 1882 and Martin (1938) made the same observation for Manitoba. In this year 17.2 percent of all homestead and sale lands entered between 1872 and 1891 were taken up. The corresponding value for the study area is 22.2 percent. The second largest number of quarter sections assigned to these two grant types that were entered in any one year also occurred in 1882. In addition, the largest number of quarter sections of any one grant type settled in a single year also occurred in 1882, when thirty-one Canadian Pacific Railway quarter sections were settled. This may reflect a response to



☐ Free Homestead (216)
▣ Dominion Lands Sale (116)
⊟ Canadian Pacific Railway (105)
◪ Hudson's Bay Company (11)
■ School Lands Sale (4)
⊠ Other (9)

Figure 8. Types of Disposition

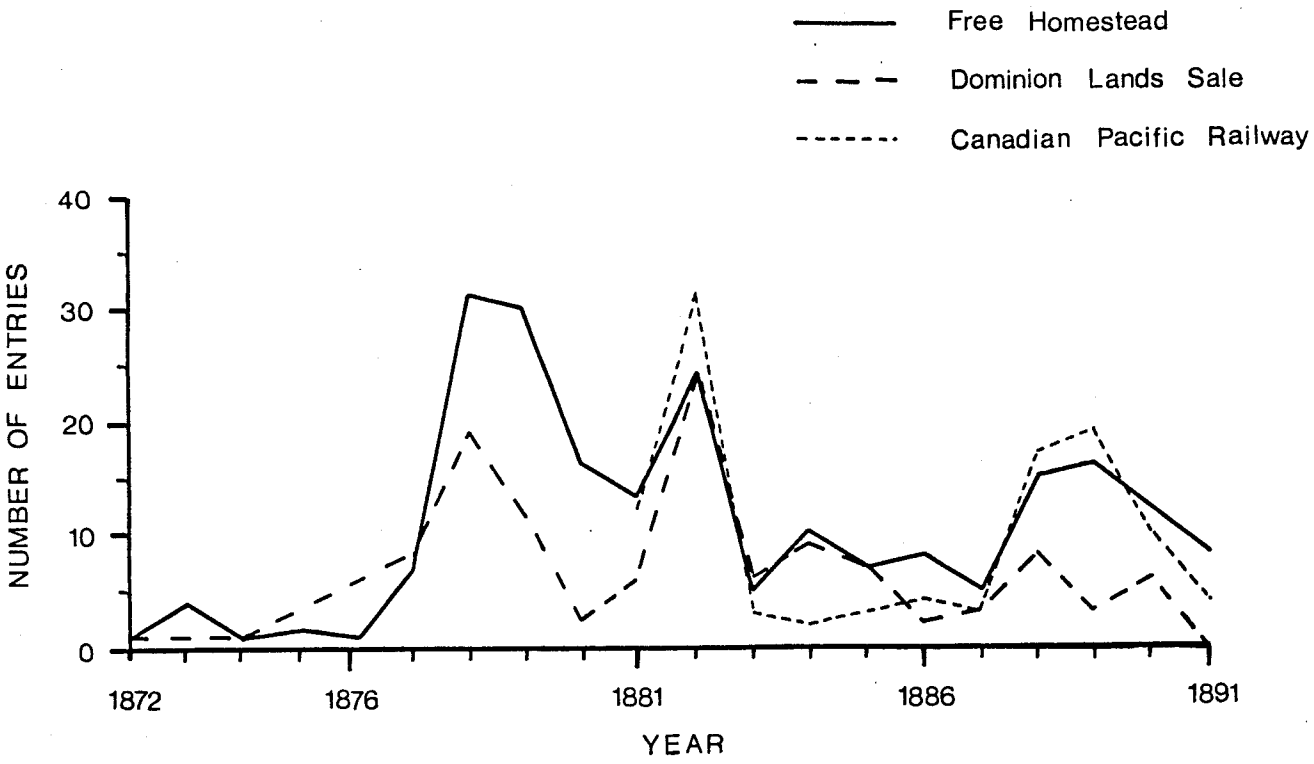


Figure 9. Free Homestead, Dominion Lands Sale and Canadian Pacific Railway Quarter Sections Entered by Year, 1872-1891

the fact that Canadian Pacific Railway quarter sections only became available for settlement in 1881.

Loveridge (1977) stated that the type of land grant of a quarter section was not an important criterion in the agricultural settler's choice of land, other than in its cost of acquisition. The availability of quarter sections, however, influenced a settler's location choice and, since the lands of certain grant types were closed to settlement for some time between 1872 and 1891, the disposition of the quarter section being considered for settlement will have influenced settlement choice to some extent. Thus, Hudson's Bay Company lands were not made available for settlement until 1879, Canadian Pacific Railway lands were not for sale until 1881 and, although one quarter section was sold in 1883, school lands were not generally for sale in this area until a public auction policy was instituted in 1888. Therefore, given this constraint imposed on land availability, it might be expected that land of a specific disposition be settled earlier relative to other grant types. A hypothesis is formulated to test the effect of grant type on date of entry as follows:

HYPOTHESIS (VII): Free homestead lands are settled before lands of other dispositions.

In order to test this hypothesis it is necessary to examine the mean year of entry of quarter sections of each grant type. The disposition having the earliest mean entry year is regarded as having been settled first. The mean, mode, median and standard deviation are calculated for each type of disposition by year of entry (Table 3). The

TABLE 3

MEAN, MODAL AND MEDIAN YEAR OF ENTRY OF QUARTER SECTIONS BY DISPOSITION, 1872-1891

Disposition	Number of Quarter Sections	Mean Year	Standard Deviation	Modal Year	Median Year
Homestead	216	1882	4.67	1878	1882
Dominion Lands Sale	116	1882	3.97	1882	1882
Canadian Pacific Railway	105	1885	3.56	1882	1887
Hudson's Bay Company	11	1886	3.64	1882 1888 1890	1888
School Land Sale	4	1886	2.50	1888	1888
Military Homestead	2	1876	0.00	1886	1886
Military Bounty Grant	1	1874	0.00	1874	1874
North-West Mounted Police Force	2	1878	0.00	1878	1878
Manitoba University Grant	2	1889	0.00	1889	1889
Special Grant	1	1879	0.00	1879	1879
Wood Lot	1	1881	0.00	1881	1881
All Types	461	1883	4.48	1882	1882

mean year of entry for the sample studied is 1883 although, when considering only the two largest disposition categories, it is shown that the mean year of entry of both homestead and sale lands is 1882. Since the mean year of these two dispositions is the same, further analysis is required in order to determine the disposition of the land that was consistently entered first. An examination of the modal year of entry reveals that the largest number of homestead lands were settled in 1878, whereas the modal year for sale lands is 1882, thereby indicating that homestead lands were entered before lands of other dispositions. Further, 4.2 percent of homestead lands were settled between 1872 and 1876 and 44.9 percent between 1877 and 1881, in contrast to 1.7 percent and 39.7 percent for sale lands in the corresponding time periods. The results therefore offer support for Hypothesis (VII) since the early settlers locating in the study area settled free homestead lands before lands of other dispositions. While perhaps not directly influencing the selection of a quarter section in relation to other economic considerations, the nature of the disposition influenced settlement in southern Manitoba during the early years of settlement, since "free" lands were settled earlier than lands that had to be purchased.

(ii) Settlement in relation to distance to the entry point, Winnipeg

Rural settlement theory indicates that land near the point of entry is settled earlier than that at a greater distance (Hudson, 1969). Richtik (1971) proposed distance to Winnipeg to be a consideration in the location decision-making process of settlers in Manitoba. Hypothesis (IV) is designed to test this proposition by analysing the distribution of quarter sections settled by year of entry in relation to

their distance to Winnipeg, the entry point for migrants to the area of southern Manitoba analysed.

HYPOTHESIS (IV): Date of entry is related to distance to the entry point, with those parcels of land nearer the entry point being settled before those at a greater distance.

The number of quarter sections available and entered in each five-year period is shown in Table 4. The quarter sections analysed were between 71.8 and 115.8 miles from the centre of Winnipeg. More than 31 percent of settlers entering land between 1872 and 1891 located on land at a distance of between 70 and 85 miles from the entry point and more than 62 percent between 70 and 100 miles. Table 4 reveals, however, that early arrivals did not all locate on the closest available land to Winnipeg. In the period between 1872 and 1876 twenty-six quarter sections were made available for settlement at a distance of between 70 and 75 miles from the entry point. Only one of the twelve settlers (8.3 percent) entering in this period located in one of the nearest available quarter sections, with a further seven (58.3 percent) selecting land at a distance of between 75 and 85 miles from Winnipeg. These eight settlers made their choice from approximately 35 percent of the available land. Similarly, between 1877 and 1881, 36.6 percent of the available land was between 70 and 90 miles from Winnipeg and could have accommodated the 160 settlers locating in this period. Only 45 (28.1 percent), however, entered land at this distance. Seventy-five (46.9 percent) of the new arrivals opted for land at a distance greater than 100 miles

TABLE 4

AVAILABILITY AND ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE

TO WINNIPEG, 1872-1891

Distance (miles)	1872-76		1877-81		1882-86		1887-91		1872-91
	No. A*	No. E**	No. A	No. E	No. A	No. E	No. A	No. E	No. E†
70.2- 75.0	26	1	31	12	19	10	10	10	33
75.2- 80.0	42	4	51	11	40	19	21	21	55
80.2- 85.0	41	3	51	17	35	16	19	19	55
85.2- 90.0	20	2	29	5	24	11	14	14	32
90.2- 95.0	28	0	41	17	24	11	13	13	41
95.2-100.0	50	2	67	23	44	20	26	26	71
100.2-105.0	43	0	56	26	30	18	12	12	56
105.2-110.0	38	0	62	34	28	15	13	13	62
110.2-115.0	23	0	53	14	39	28	12	12	54
115.2-120.0	0	0	2	1	1	1	0	0	2
Total	311	12	443	160	284	149	140	140	461

* No. A = Number Available; ** No. E = Number Entered; † No. E = No. A.

from Winnipeg, with most entries in this five-year period being recorded at a distance of between 105 and 110 miles. The period from 1882 to 1886 reveals a similar tendency, that is, settlers did not enter the closest available land. If this had been the case, all entries would have been made at a distance of between 70 and 100 miles from Winnipeg by the end of the time-period, leaving only the more distant quarter sections available for settlement in the subsequent time-period. There is a lack of relationship between proximity to Winnipeg and date of entry of the quarter sections analysed as the correlation coefficient, r, of -0.08 indicates. Hypothesis (V) cannot be accepted since there is no evidence to suggest that parcels of land located nearer the entry point were settled before those at a greater distance. As already noted, the significance of this important result is assessed in Chapter V.

(iii) Settlement in relation to distance to the nearest trail

Prior to railway construction travel was principally along trails. Settlers wishing to locate in the area analysed could reach quarter sections in different parts of the area by following either the northern branch of the Saskatchewan trail, also known as the Fort Ellice trail, the southern branch of the Saskatchewan trail or the Yellow Quill trail (Figure 2). Bylund's (1960) E-model suggested that settlers sought to minimise the distance between their settlement location and an available communication link and Weir (1964) proposed that in southwestern Manitoba trails were a control in guiding the lines of settlement. In order to test these proposals, Hypothesis (I) is formulated.

HYPOTHESIS (I): Date of entry is related to distance to the nearest trail, with those parcels of land nearer the trail being settled before those at a greater distance.

All quarter sections settled by 1891 were within 15 miles of a trail, of which 67.4 percent (311) were within 5 miles (Table 5). The mean distance of quarter sections to the nearest trail in each of the five-year periods is between 1 and 5 miles. It is apparent from Table 5 that not all of the settlers locating in each time-period entered the available land that was closest to the nearest trail. By 1876 only 33.3 percent of the settlers entered land less than one mile from the nearest trail, although all could have been accommodated at this distance. Similarly, in the period between 1877 and 1881 only 15 percent of the settlers occupied land at this distance, although 48 percent of those entering land at this time could have located at a distance of less than one mile from the nearest transport artery. Between 1882 and 1886, 36.2 percent of those settling could have occupied a quarter section at this distance, but only 20.1 percent entered such land.

Neither the results of the computation of the mean year of entry for each distance category for the period between 1872 and 1891 nor the mean year of entry for each category during each of the five-year periods verifies the hypothesis (Table 6). The mean year of entry of quarter sections situated at a distance of between 5 and 10 miles from a trail in the period ending in 1876 is 1872, whereas the mean year of entry for nearer locations is 1874. For the period ending in 1881, the mean year for lands at less than 10 miles' distance is 1879, whereas

TABLE 5

AVAILABILITY AND ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE

TO THE NEAREST TRAIL, 1872-1891

Distance (miles)	1872-76		1877-81		1882-86		1887-91		1872-91
	No. A*	No. E**	No. A	No. E	No. A	No. E	No. A	No. E	No. E†
0.0- 1.0	62	4	78	24	54	30	26	26	84
1.2- 5.0	171	7	218	84	135	69	67	67	227
5.2-10.0	71	1	130	47	83	41	44	44	133
10.2-15.0	7	0	7	5	12	9	3	3	17
Total	311	12	433	160	284	149	140	140	461

* No. A = Number Available; ** No. E = Number Entered; † No. E = No. A.

TABLE 6

MEAN YEAR OF ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE

TO THE NEAREST TRAIL, 1872-1891

Distance (miles)	1872-76	1877-81	1882-86	1887-91	1872-91
0.0- 1.0	1874	1879	1883	1889	1886
1.2- 5.0	1874	1879	1883	1889	1885
5.2-10.0	1872	1879	1883	1889	1886
10.2-15.0	-	1880	1883	1888	1885

for those further away it is 1880. The mean year of entry of quarter sections located at any distance from the trail in the period between 1882 and 1886 is 1883. During the period ending in 1891, also, quarter sections at a greater distance from the trail were settled before those in a nearer location. Specifically, the mean year of entry of land further than 10 miles was 1888 and, for that within 10 miles, 1889. Further, an r value of 0.05 between the distance to the nearest trail and the date of entry of quarter sections indicates that there is no relationship between the two variables. Hypothesis (I) cannot be accepted.

(iv) Settlement in relation to distance to the nearest service centre

HYPOTHESIS (III): Date of entry is related to distance to the nearest service centre, with those parcels of land nearer the centre having greater accessibility and being settled before those at a greater distance.

In addition to the distance to Winnipeg and nearest transport route, the minimisation of distance to the nearest service centre was desired by the early settlers (Bylund, 1960). By 1876, the four service centres of Carberry, Gladstone, Golden Stream and Woodside were in existence in the area analysed and by 1891 the number of centres had increased to twenty-two, principally along the railway lines (Figure 2). New settlements were built at regular intervals as railway construction progressed and these stations thus provided disembarking as well as

loading points.

All settlers locating by 1876 chose quarter sections that were less than 20 miles from the nearest service centre. Of these, approximately 66 percent settled within 5 miles of such a centre. For the period between 1872 and 1876 an r value of 0.76 is recorded between proximity to the nearest service centre and date of entry, indicating a strong relationship between these two variables. This figure must be regarded with caution, however, since during this period only twelve individuals entered land. The r values for 1881, 1886 and 1891 are 0.14, 0.08 and 0.11, respectively, revealing a virtual absence of any relationship between distance to the nearest service centre and date of entry. An analysis of the mean year of entry for quarter sections at specific distances from the nearest service centre in each five-year period (Table 7) supports the argument that there is virtually no relationship between proximity to the centre and date of entry.

TABLE 7

MEAN YEAR OF ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE TO THE NEAREST SERVICE CENTRE, 1872-1891

Distance (miles)	1872-76	1877-81	1882-86	1887-91
0.0- 1.0	1873	1880	1883	1890
1.2- 5.0	1873	1879	1883	1889
5.2-10.0	1875	1879	1883	1889
10.2-15.0	1875	1879	1883	1890
15.2-20.0	1875	1879	-	-
20.2-25.0	-	1879	-	-
25.2-30.0	-	1880	-	-

In the five-year period between 1872 and 1876 the mean year of entry of land within 5 miles of a service centre was 1873 and the mean year of entry of more distant land was 1875. This is insufficient evidence on which to accept Hypothesis (III) since these results are based on only twelve sample observations. No support for the hypothesis is evident from the results of the analysis of subsequent five-year periods. During the periods ending in 1881 and 1891 land at a distance of less than one mile was, in fact, settled after more distant land had been entered. For the five-year period between 1881 and 1886 there is no variation in the mean year of entry of land at different distances from the service centre, the mean year being 1883 for land at any distance. Hypothesis (III) cannot be accepted.

(v) Settlement in relation to distance to the nearest railway loading point

Trails were not the only type of communication link to which distance was to be minimised by early settlers. In 1881 the Canadian Pacific Railway main line provided a major east-west connection across the area analysed between Portage-la-Prairie and Brandon, and by 1891 two additional lines had been constructed in the area (Figure 2). Accessibility to a railway loading point is assumed to have been an important consideration in the early settler's decision-making process (Dick, 1980). The following hypothesis is tested:

HYPOTHESIS (II): Date of entry is related to distance to the nearest railway loading point, with those parcels of land nearer the loading point

being settled before those at a greater distance.

Correlation coefficients are analysed in order to assess the relationship between the distance of the quarter section to the nearest railway loading point and the year in which that quarter section was entered. The r values are 0.11, 0.02 and 0.06 for the five-year periods ending in 1881, 1886 and 1891, respectively, indicating virtually no relationship between the two variables. The mean year of entry of land at different distances to the nearest railway loading point between 1877 and 1891 further illustrates the virtual absence of any relationship between the variables (Table 8). The mean year of entry of all but one of the quarter sections entered between 1877 and 1881 was 1879, with the remaining quarter section, at a distance of between 25 and 30 miles, being settled in 1880.

TABLE 8

MEAN YEAR OF ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE TO THE NEAREST RAILWAY LOADING POINT, 1877-1891

Distance (miles)	1877-81	1882-86	1887-91
0.0- 1.0	-	1883	1889
1.2- 5.0	1879	1883	1889
5.2-10.0	1879	1883	1889
10.2-15.0	1879	1883	1889
15.2-20.0	1879	1883	-
20.2-25.0	1879	-	-
25.2-30.0	1880	-	-

Since there is no variation in the mean year of entry of quarter sections at different distances from the nearest railway loading point in any of the five-year periods analysed, Hypothesis (II) cannot be accepted. With the construction of additional railway lines through time, an increasing percentage of settlers was able to locate closer to a railway line (Table 9; Figures 2 and 5).

TABLE 9

ENTRY OF QUARTER SECTIONS IN RELATION TO DISTANCE TO THE NEAREST RAILWAY LOADING POINT, 1877-1891

Distance (miles)	1877-81 Number Entered	1882-86 Number Entered	1887-91 Number Entered	1877-91 Number Entered
0.0- 1.0	0	8	5	13
1.2- 5.0	24	69	87	180
5.2-10.0	30	44	43	117
10.2-15.0	32	23	5	60
15.2-20.0	31	5	-	36
20.2-25.0	42	-	-	42
25.2-30.0	1	-	-	1
Total	160	149	140	449

Of the farmers who settled in the area between 1877 and 1881, 53.8 percent were less than 15 miles from the nearest loading point. By 1886 the percentage had increased to 96.6 percent and by 1891 all quarter sections entered were within 15 miles of the nearest loading point. By 1891, in fact, 65.7 percent of the land entered was less than 5 miles from such a facility. In the area analysed 87.9 percent of the land

entered by 1890 was within 10 miles of a railway line. This accords with Studness' (1964, p. 581) finding that by this date "of the area west of the Red River and within 110 miles of the international boundary, only the southwestern corner of the province contained a significant acreage that was not within ten miles of a railway."

(vi) The importance of flowing surface water and woodland in settlement

The importance of the presence of flowing water and woodland to the early settlers has been noted (Murchie, 1936 ; Richtik, 1971; Weir, 1964). Hypothesis (V) is formulated to test the importance of these variables on the date of settlement of land in the study area up to 1881.

HYPOTHESIS (V): Date of entry of a parcel of land is determined by the presence or absence of flowing surface water and woodland, with those parcels possessing both of these environmental features being settled before those possessing only one or neither.

Quarter sections settled between 1872 and 1881 are divided into three categories, depending on whether they possess either water or woodland, both water and woodland or neither water nor woodland (Table 10).

TABLE 10

MEAN YEAR OF ENTRY OF QUARTER SECTIONS IN RELATION TO FLOWING SURFACE WATER AND WOODLAND, 1872-1881

	Water or Woodland Present	Water and Woodland Present	Neither Water nor Woodland Present
1872-76	1874	1874	1874
1877-81	1879	1879	1879

In order to test Hypothesis (V) the mean year of entry is calculated for quarter sections in each category. Results indicate that there is no difference between the mean year of entry of quarter sections in each of the three categories for either of the five-year periods. For the earlier period the mean year is 1874 and for the period ending in 1881 it is 1879. Since those parcels of land possessing both flowing surface water and woodland are not settled earlier than those possessing only one or neither of these environmental features, Hypothesis (V) cannot be accepted. Results recorded in Table 11 indicate that the number of available quarter sections possessing both flowing surface water and woodland in 1876 was greater than the total number of settlers locating by that year. Although all settlers locating between 1872 and 1876 could have entered land possessing both flowing surface water and woodland, only 41.7 percent claimed quarter sections possessing these environmental features. Similarly, the number of quarter sections available between 1877 and 1881 indicates that all of the 160 individuals settling in that period could have entered land possessing either one or both of

TABLE 11

ENTRY OF QUARTER SECTIONS IN RELATION TO FLOWING SURFACE WATER AND WOODLAND, 1872-1881

	Water				Woodland				Water or Woodland				Water and Woodland	
	Present		Absent		Present		Absent		Present		Absent		Present	
	No.A*	No.E**	No.A	No.E	No.A	No.E	No.A	No.E	No.A	No.E	No.A	No.E	No.A	No.E
1872-76	53	5	258	7	181	10	130	2	150	5	119	2	42	5
1877-81	48	26	369	134	275	83	168	77	223	73	157	69	63	18

* No. A = Number Available; ** No. E = Number Entered.

the physical characteristics considered. Instead, only 56.9 percent settled on land of this type. If the presence of flowing surface water and woodland was indeed of prime importance to the early settler, this is not borne out by the results obtained in this study.

(vii) Settlement in relation to land quality

HYPOTHESIS (VI): Date of entry is related to land quality, with those parcels of land possessing land with the greatest soil capability for agriculture being occupied before those of inferior quality.

A land quality value is calculated for each quarter section using the method outlined in Chapter III. The values of 800 and 100 indicate land possessing soil of the greatest and least capability for agricultural purposes, respectively. No quarter section analysed was assigned a value of less than 300 and 25 had a value of 800 (Table 12). Between 1872 and 1876 the mean year of entry of quarter sections having a value of 600 or greater was 1873 (Table 13). These quarter sections form 41.7 percent of those entered in this period. Land of inferior quality was, on average, entered at a later date, namely 1874. No pattern of occupancy in relation to land quality is evident between 1877 and 1886, although in the five-year period ending in 1891 the one quarter section having an assigned value of 800 was settled a year earlier than land of lesser capability for agriculture. During the five-year periods ending in 1876 and 1891 land of the highest quality was settled

TABLE 12

AVAILABILITY AND ENTRY OF QUARTER SECTIONS IN RELATION TO LAND QUALITY, 1872-1891

Land Quality	1872-76		1877-81		1882-86		1887-91		1872-91
	No. A*	No. E**	No. A	No. E	No. A	No. E	No. A	No. E	No. E†
300-399	19	0	30	2	28	8	20	20	30
400-499	36	0	54	6	48	22	26	26	54
500-599	65	7	98	30	68	36	34	34	107
600-699	101	3	141	55	87	45	42	42	145
700-799	66	2	96	47	49	34	17	17	100
800	24	0	24	20	4	4	1	1	25
Total	311	12	443	160	284	149	140	140	461

* No. A = Number Available; ** No. E = Number Entered; † No. E = No. A.

TABLE 13

MEAN YEAR OF ENTRY OF QUARTER SECTIONS IN RELATION TO

LAND QUALITY, 1872-1891

Land Quality	1872-76	1877-81	1882-86	1887-91	Number Entered
300-399	-	1881	1883	1889	30
400-499	-	1879	1883	1889	54
500-599	1874	1879	1883	1889	107
600-699	1873	1879	1883	1889	145
700-799	1873	1879	1883	1889	100
800	-	1879	1883	1888	25
Total					461

before land of inferior quality. However, since this applies to only 6 (1.3 percent) of the 461 quarter sections entered between 1872 and 1891, Hypothesis (VI) cannot be accepted. Information provided in Table 12 demonstrates that the available land of the highest soil capability for agriculture was not settled to its capacity. During the period ending in 1876 none of the settlers entered land of the highest quality, although sufficient land of this type was available. Rather, 58.3 percent of the settlers entered land assigned values of between 500 and 599. The 160 settlers locating between 1877 and 1881 could all have been accommodated in quarter sections possessing land in the three highest land quality classes. Only 122 (76.3 percent), however, located on land assigned a value greater than 600. Between 1882 and 1886 all settlers might have located on land assigned a value of at least 500 and almost 80 percent of the quarter sections entered during this five-year period possessed land having an assigned value greater than 500.

4. Stepwise Multiple Regression Analysis

The descriptive analysis of the process allows only for the possible effect of individual variables on date of entry to be tested. It is, however, desirable to test the combined effect of a number of variables, namely the postulated process, on date of entry. The contribution of the independent variables in the settlement process is assessed in relation to their effect on the spatial form of date of entry using stepwise multiple regression analysis.

(a) The Regression Model

Since the settlement process changes between 1872 and 1891, it is analysed during four sub-periods. The four five-year periods are 1872 to 1876, 1877 to 1881, 1882 to 1886 and 1887 to 1891. A process-model is formulated to correspond with each period such that the importance of the incorporated variables may be assessed in the relevant period as well as through time. The results are discussed and assessed in Chapter V.

The multiple regression models are of the general form:

$$X_0 = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_nX_n$$

where X_0 denotes the dependent variable and X_1, X_2, X_3, . . . , X_n denote the independent variables. The b values are partial regression coefficients (b). Each b value gives the rate of change in the dependent variable, provided all other variables are held constant. A multiple regression equation with three independent variables, for example, is therefore written correctly as:

$$X_0 = a + b_{01.23}X_1 + b_{02.13}X_2 + b_{03.12}X_3$$

where the subscript 0 represents the dependent variable. For simplicity, the notation used in this study corresponds to that used in the above notation of the general form of a multiple regression model.

(b) Variables Included in the Process-Model

The selection of variables is based on theory and empirical works. The following notation is used to identify the variables in the process-models for the sub-periods. Appropriate distance measures are

calculated for the periods ending in 1876, 1881, 1886 and 1891.

X_0 = Date of entry

X_1 = Land quality

X_2 = Flowing surface water

X_3 = Woodland

X_4 = Distance to the entry point, Winnipeg

X_5 = Distance to the nearest service centre

X_6 = Distance to the nearest trail

X_7 = Distance to the nearest railway loading point

Of these variables X_2 and X_3 are dummy variables.

(c) Analysis of Process-Models

As indicated, stepwise multiple regression is used in the analysis of the process-models. The programme used for this analysis is the SPSS Subprogram Regression (Nie, 1975). Four stepwise multiple regression models are tested, each using date of entry as the dependent variable. Each model is analysed in turn and is followed by a comparison of the results. F-tests are used to test the statistical significance of the regression and correlation coefficients at the 0.05 level.

(i) Model (1): 1872-1876

This model is formulated to assess the importance of the selected independent variables in accounting for variations in the date of entry of quarter sections between 1872 and 1876 and is of the general form:

$$X_0 = a + b_1X_1 + b_1X_1 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$$

where X_0 to X_6 correspond to the definitions presented above. The matrix of simple correlation coefficients for this model is presented in Table 14 and Table 15 summarises each step in regression model (1).

Distance to the nearest service centre (X_5) has the highest simple correlation with the date of entry (X_0) (Table 14) and is therefore the first independent variable to enter the regression equation. This yields a simple correlation value, r, of 0.7562 which is significant at the 0.05 level. The equation at the first step is thus as follows:

$$X_0 = 72.721 + 0.747X_5$$

Distance to the nearest service centre (X_5) in this step accounts for 57.2 percent of the variation in the date of entry. At step 2 the variable with the highest partial r value in step 1 is entered into the equation and a revised equation is generated. Land quality (X_1) is entered at this stage since, with a partial r value of -0.3836, it accounts for the largest proportion of the variation in the dependent variable among the variables not included in the equation, after variation due to the included independent variable is considered. The addition of this variable results in an increase in the multiple coefficient of determination, R^2, of 0.0647. R^2 "explains" the variation in the dependent variable accounted for by the independent variables in the equation. Neither the increase in R^2 nor the partial b value of X_1 is significant at the 0.05 level. Since the addition of further independent variables to the equation does not result in a significant increase in R^2, a decision might have been made at this stage to enter no

TABLE 14

SIMPLE CORRELATION COEFFICIENTS, 1872-1876

	X_0	X_1	X_2	X_3	X_4	X_5	X_6
X_0	1.000	-0.527*	0.096*	0.063*	0.336*	0.756*	-0.301*
X_1		1.000	-0.015*	0.197*	-0.085*	-0.387*	0.746*
X_2			1.000	0.378*	0.340*	0.094*	0.295†
X_3				1.000	-0.039*	0.203†	0.214†
X_4					1.000	0.593*	-0.171*
X_5						1.000	-0.237†
X_6							1.000

Number of cases = 12

* = significant at the 0.05 level; † = not significant at the 0.05 level.

TABLE 15. SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (1), 1872-1876

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OF ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_5	0.7562*	0.8448	0.5718	0.5718*	72.7211	b_5 = 0.7465*	0.2043	X_1	-0.3836	0.1472
									X_2	0.0372	0.0014
									X_3	-0.1408	0.0198
									X_4	-0.2130	0.0454
									X_6	-0.1920	0.0369
2	X_1	0.7978*	0.8205	0.6365	0.0647†	75.1778	b_1 = -0.0040†	0.0031	X_2	0.0502	0.0025
							b_5 = 0.6410*	0.2152	X_3	-0.0253	0.0006
									X_4	-0.1517	0.0230
									X_6	0.1454	0.0211
3	X_4	0.8030*	0.8602	0.6449	0.0084†	76.5753	b_1 = -0.0037†	0.0036	X_2	0.1129	0.0128
							b_4 = -0.0801†	0.1848	X_3	-0.0716	0.0051
							b_5 = 0.7164*	0.2847	X_6	0.1098	0.0121
4	X_2	0.8058†	0.9137	0.6494	0.0045†	76.9199	b_1 = -0.0036†	0.0036	X_3	-0.1570	0.0247
							b_2 = 0.1729†	0.5753	X_6	0.0517	0.0027
							b_4 = -0.1025†	0.2097			
							b_5 = 0.7301*	0.3058			
5	X_3	0.8112†	0.9747	0.6580	0.0086†	77.6504	b_1 = -0.0029†	0.0042	X_6	-0.0279	0.0008
							b_2 = 0.3239†	0.7260			
							b_3 = -0.3886†	0.9979			
							b_4 = -0.1503†	0.2552			
							b_5 = 0.8084*	0.3832			
F-level insufficient for further computation.											

* = significant at the 0.05 level † = not significant at the 0.05 level

further variables into the equation. It is desired, however, to record the order in which independent variables enter the equation to enable a comparison to be made with the order of entry in the other models. The final variable entered into the equation is woodland (X_3) which accounts for only an additional 0.9 percent of the variation in date of entry, resulting in a final R value of 0.8112 and corresponding R^2 value of 0.6580. The five variables thus account for 65.8 percent of the variation in X_0. The final regression equation, including variables with partial b values non-significant at the 0.05 level is:

$$X_0 = 77.650 + 0.808X_5 - 0.003X_1 - 0.150X_4 + 0.324X_2 - 0.389X_3$$

When the variables with non-significant partial b values are deleted, the final equation is significant at the 0.05 level as follows:

$$X_0 = 77.650 + 0.808X_5$$

The positive sign of the partial b value indicates that land closer to a service centre was entered before land at a greater distance.

(ii) Model (2): 1877-1881

Model (2) is formulated to represent the process operating between 1877 and 1881 and is of the general form:

$$X_0 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where X_0 to X_7 refer to the variables defined previously. The matrix of simple correlation coefficients for this sub-period is presented in Table 16 and a summary of the results of stepwise regression in model

TABLE 16

SIMPLE CORRELATION COEFFICIENTS, 1877-1881

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_0	1.000	-0.115*	0.062*	0.146*	0.136*	0.140*	0.297*	0.109*
X_1		1.000	-0.124*	-0.272*	0.121*	0.065*	-0.182*	-0.090*
X_2			1.000	0.153*	-0.027*	0.074*	0.162*	0.161*
X_3				1.000	-0.024*	0.036*	0.309*	0.348*
X_4					1.000	-0.157*	-0.052*	0.065*
X_5						1.000	0.381*	0.518*
X_6							1.000	0.558*
X_7								1.000

Number of cases = 160

* significant at the 0.05 level.

TABLE 17. SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (2), 1877-1881

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OF ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_6	0.2972*	1.2295	0.0883	0.0883*	78.4505	b_6 = 0.5597*	0.1431	X_1	-0.0643	0.0041
									X_2	0.0146	0.0002
									X_3	0.0501	0.0025
									X_4	0.1591	0.0253
									X_5	0.0309	0.0010
									X_7	-0.0716	0.0051
2	X_4	0.3338*	1.2177	0.1114	0.0231*	76.8818	b_4 = 0.0646*	0.0320	X_1	-0.0841	0.0071
							b_6 = 0.5746*	0.1419	X_2	0.0179	0.0003
									X_3	0.0622	0.0039
									X_5	0.0559	0.0031
									X_7	-0.0913	0.0083
3	X_7	0.3447*	1.2165	0.1188	0.0074†	76.9354	b_4 = 0.0687*	0.0322	X_1	-0.0843	0.0071
							b_6 = 0.6852*	0.1715	X_2	0.0252	0.0006
							b_7 = -0.0763†	0.0660	X_3	0.0853	0.0073
									X_5	0.1048	0.0120
4	X_5	0.3584*	1.2137	0.1285	0.0097†	76.6695	b_4 = 0.0779*	0.0328	X_1	-0.1060	0.0112
							b_5 = 0.0894†	0.0682	X_2	0.0295	0.0009
							b_6 = 0.6607*	0.1721	X_3	0.1110	0.0123
							b_7 = -0.1159*	0.0727			
5	X_3	0.3731*	1.2101	0.1392	0.0107†	76.5280	b_3 = 0.2932†	0.2115	X_1	-0.0854	0.0073
							b_4 = 0.0816*	0.0328	X_2	0.0200	0.0004
							b_5 = 0.1102†	0.0696			
							b_6 = 0.6199*	0.1741			
							b_7 = -0.1468*	0.0758			
6	X_1	0.3814*	1.2096	0.1455	0.0063†	77.1159	b_1 = -0.0011†	0.0010	X_2	0.0135	0.0002
							b_3 = 0.2458†	0.2161			
							b_4 = 0.0864*	0.0331			
							b_5 = 0.1206*	0.0703			
							b_6 = 0.5945*	0.1757			
							b_7 = -0.1479*	0.0758			
7	X_2	0.3816*	1.2135	0.1456	0.0002†	77.1042	b_1 = -0.0010†	0.0010			
							b_2 = 0.0443†	0.2666			
							b_3 = 0.2433†	0.2174			
							b_4 = 0.0865*	0.0333			
							b_5 = 0.1206*	0.0705			
							b_6 = 0.5928*	0.1766			
							b_7 = -0.1487*	0.0762			

* = significant at the 0.05 level † = not significant at the 0.05 level

(2) is presented in Table 17.

During this time-period distance to the nearest trail (X_6) is the first independent variable to enter the equation, producing an r value of 0.2972. Distance to the entry point, Winnipeg, (X_4) is the variable entered at the next step. The two variables together account for an R^2 value of 0.1114 or 11.1 percent and subsequent entries of independent variables do not register significant increases in R^2. Following these two distance variables, distance to the nearest railway loading point (X_7) and distance to the nearest service centre (X_5) are entered into the equation, and are followed in turn by woodland (X_3), land quality (X_1) and flowing surface water (X_2). These five variables together account for 3.4 percent of the variation in X_0. This amounts to a total of 14.6 percent of the variation of X_0 being accounted for by the independent variables entered in the equation. The final estimating equation is:

$$X_0 = 77.104 + 0.593X_6 + 0.087X_4 - 0.149X_7 + 0.121X_5 + 0.243X_3 - 0.001X_1 + 0.044X_2$$

When the variables with non-significant partial b values are deleted, the equation is:

$$X_0 = 77.104 + 0.593X_6 + 0.087X_4 - 0.149X_7 + 0.121X_5$$

A positive relationship between the independent variables, distance to the nearest trail (X_6), distance to the entry point, Winnipeg, (X_4) and distance to the nearest service centre (X_5) and the dependent variable, date of entry (X_0) is confirmed by the signs of the significant partial b values. The negative sign for the partial b value of distance to the

nearest railway loading point (X_7) may be a reflection of the fact that the railway was only in existence in the final year of this sub-period.

(iii) Model (3): 1882-1886

Like model (2), this model for the period between 1882 and 1886 is of the general form:

$$X_0 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where the notations are the same as before. Simple correlation coefficients for this model are shown in Table 18, and the results of model (3) are summarised in Table 19. The independent variable, distance to the entry point, Winnipeg, (X_4) has the highest simple correlation with the dependent variable (X_0) with a coefficient of -0.154 and is therefore the first independent variable to enter the regression equation but does not register a value of r that is significant at the stated level. Distance to the nearest service centre (X_5) accounts for most of the remaining variation in X_0 (3.1 percent). This variable enters the equation at step 2 and significantly increases the value of R^2 for the two included variables to 5.4 percent. The largest variation in X_0, after X_4 and X_5 are entered into the equation, is accounted for by flowing surface water (X_2) and this variable thus enters the equation at step 3. At this step X_2 does not have a significant partial b value and does not contribute significantly to an increase in R^2. The final estimating equation, excluding variables with non-significant partial b values, however, includes X_2 and is as follows:

$$X_0 = 86.011 - 0.128X_4 + 0.391X_5 + 0.536X_2$$

TABLE 18

SIMPLE CORRELATION COEFFICIENTS, 1882-1886

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_0	1.000	-0.079*	0.111*	0.020*	-0.154*	0.080*	0.018*	0.021*
X_1		1.000	-0.154*	-0.407*	0.096*	-0.110*	0.117*	-0.066*
X_2			1.000	0.360*	-0.114*	-0.142*	0.027*	-0.057*
X_3				1.000	-0.274*	-0.047*	-0.206*	-0.121*
X_4					1.000	0.478*	0.139*	0.614*
X_5						1.000	-0.068*	0.754*
X_6							1.000	-0.043*
X_7								1.000

Number of cases = 149

* = significant at the 0.05 level.

TABLE 19. SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (3), 1882-1886

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OF ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_4	0.1537†	1.4333	0.0236	0.0236†	84.7472	b_4 = -0.0676†	0.0359	X_1 X_2 X_3 X_5 X_6 X_7	-0.0651 0.0955 -0.0239 0.1754 0.0405 0.1482	0.0042 0.0091 0.0006 0.0308 0.0016 0.0220
2	X_5	0.2324*	1.4157	0.0540	0.0304*	85.2511	b_4 = -0.1094* b_5 = 0.3941*	0.0403 0.1820	X_1 X_2 X_3 X_6 X_7	-0.0348 0.1155 -0.0422 0.0696 0.0423	0.0012 0.0133 0.0018 0.0048 0.0018
3	X_2	0.2581*	1.4111	0.0666	0.0126†	85.0761	b_2 = 0.4455† b_4 = -0.1064* b_5 = 0.4196*	0.0403 0.1823 0.3181	X_1 X_3 X_6 X_7	-0.0160 -0.0900 0.0667 0.0297	0.0003 0.0081 0.0044 0.0009
4	X_3	0.2724*	1.4102	0.0742	0.0076†	85.5021	b_2 = 0.5774* b_3 = -0.2859† b_4 = -0.1195* b_5 = 0.4482*	0.3404 0.2636 0.0420 0.1841	X_1 X_6 X_7	-0.0518 0.0510 0.0256	0.0027 0.0026 0.0007
5	X_1	0.2769*	1.4132	0.0767	0.0025†	85.9371	b_1 = -0.0007† b_2 = 0.5707* b_3 = -0.3485† b_4 = -0.1179* b_5 = 0.4303*	0.0012 0.3413 0.2828 0.0422 0.1867	X_6 X_7	0.0522 0.0225	0.0027 0.0005
6	X_6	0.2814†	1.4163	0.0792	0.0025†	85.9034	b_1 = -0.7255† b_2 = 0.5503* b_3 = -0.3185† b_4 = -0.1216* b_5 = 0.4445* b_6 = 0.9584†	0.0012 0.3436 0.2875 0.0427 0.1885 0.1539	X_7	0.0277	0.0008
7	X_7	0.2827†	1.4207	0.0799	0.0007†	86.0112	b_1 = -0.0007† b_2 = 0.5356* b_3 = -0.3107† b_4 = -0.1283* b_5 = 0.3906* b_6 = 0.1007† b_7 = 0.0650†	0.0012 0.3476 0.2894 0.0474 0.2502 0.1551 0.1975			

* = significant at the 0.05 level † = not significant at the 0.05 level

These results indicate that there is a relationship between date of entry of quarter sections and their characteristics based on distance to the entry point, Winnipeg, (X_4), the nearest service centre (X_5) and flowing surface water (X_2). The amount of R^2 attributable to the remaining four variables--woodland (X_3), land quality (X_1), distance to the nearest trail (X_6) and distance to the nearest railway loading point (X_7)--is small. The total amount of variation in X_0 accounted for by the independent variables is 8.0 percent. The final equation, including variables with non-significant partial b values is:

$$X_0 = 86.011 - 0.128X_4 + 0.391X_5 + 0.536X_2 - 0.311X_3 - 0.001X_1 + 0.101X_6 + 0.065X_7$$

This means that there is a greater than 5 percent probability that actual values will differ from the regression line by more than twice the standard error.

(iv) Model (4): 1887-1891

Model (4) is designed to determine the relationship between the dependent and independent variables for the period between 1887 and 1891. It is of the general form:

$$X_0 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where all the variables are defined as previously.

Simple correlation coefficients are presented in matrix form in Table 20 and the results of the test of model (4) are summarised in Table 21. Land quality (X_1) has the largest simple correlation with date of entry and is therefore the first independent variable to be

TABLE 20

SIMPLE CORRELATION COEFFICIENTS, 1887-1891

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_0	1.000	-0.201*	-0.001*	0.146*	-0.030*	0.112*	-0.130*	0.061*
X_1		1.000	0.017*	-0.121*	-0.024*	-0.090*	-0.023*	0.027*
X_2			1.000	0.121*	-0.158*	0.018*	0.126*	-0.033*
X_3				1.000	-0.026*	-0.094*	-0.018*	-0.197*
X_4					1.000	-0.100*	0.158*	0.030*
X_5						1.000	-0.113*	0.866†
X_6							1.000	-0.156†
X_7								1.000

Number of cases = 140

* = significant at the 0.05 level; † = not significant at the 0.05 level.

TABLE 21. SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (4), 1887-1891

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OF ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_1	0.2007*	1.0878	0.0403	0.0403*	89.9141	b_1 = -0.0019*	0.0008	X_2	0.0028	0.0000
									X_3	0.1256	0.0158
									X_4	-0.0360	0.0013
									X_5	0.0952	0.0091
									X_6	-0.1373	0.0189
									X_7	0.0680	0.0046
2	X_6	0.2415*	1.0814	0.0583	0.0181†	90.1423	b_1 = -0.0019*	0.0008	X_2	0.0205	0.0004
							b_6 = -0.2139†	0.1319	X_3	0.1239	0.0154
									X_4	-0.0147	0.0002
									X_5	0.0817	0.0067
									X_7	0.0476	0.0023
3	X_3	0.2698*	1.0770	0.0728	0.0145†	89.8202	b_1 = -0.0018*	0.0008	X_2	0.0049	0.0000
							b_3 = 0.3181†	0.2184	X_4	-0.0115	0.0001
							b_6 = -0.2099†	0.1314	X_5	0.0956	0.0091
									X_7	0.0747	0.0056
4	X_5	0.2854*	1.0759	0.0814	0.0085†	89.5266	b_1 = -0.0017*	0.0008	X_2	0.0001	0.0000
							b_3 = 0.3452*	0.2195	X_4	-0.0029	0.0000
							b_5 = 0.1924†	0.1707	X_7	-0.0196	0.0004
							b_6 = -0.1923*	0.1321			
5	X_7	0.2860*	1.0797	0.0818	0.0004†	89.5307	b_1 = -0.0016*	0.0008	X_2	-0.0012	0.0000
							b_3 = 0.3341†	0.2257	X_4	0.0025	0.0000
							b_5 = 0.2617†	0.3501			
							b_6 = -0.1961†	0.1337			
							b_7 = -0.0735†	0.3241			
F-level insufficient for further computation.											

* = significant at the 0.05 level † = not significant at the 0.05 level

entered into the equation and registers an r value of 0.2007. Distance to the nearest trail (X_6) enters the equation at step 2, having had the highest partial r value in step 1. Neither this variable nor the independent variables subsequently entering the equation results in a significant increase in R^2. The variables woodland (X_3), distance to the nearest service centre (X_5) and distance to the nearest railway loading point (X_7) are successively entered into the equation, accounting for a total R value of 0.2860. Neither flowing surface water (X_2) nor distance to the entry point, Winnipeg, (X_4) are entered into the equation since their F-levels are too low to allow further computation at step 5. The final estimating equation is:

$$X_0 = 89.531 - 0.002X_1 - 0.196X_6 + 0.334X_3 + 0.262X_5 - 0.735X_7$$

When variables with non-significant partial b values are deleted, the equation is:

$$X_0 = 89.531 - 0.002X_1$$

The sign of the significant partial b value is negative, indicating a relationship between date of entry (X_0) and land quality (X_1), namely that land of superior quality was entered before that of an inferior nature.

(d) Summary of Results

(i) Simple correlation coefficients

Table 22 presents the simple r values for each independent variable with the dependent variable between 1872 and 1891. There is an overall decline in the r values through time, indicating a decline in

TABLE 22

CHANGE IN SIMPLE CORRELATION COEFFICIENTS WITH DATE OF ENTRY, 1872-1891

Variable	1872-76	1877-81	1882-86	1887-91
Land quality (X_1)	-0.527*	-0.115*	-0.079*	-0.201*
Flowing surface water (X_2)	0.096*	0.062*	0.111*	-0.001*
Woodland (X_3)	0.063*	0.146*	0.020*	0.146*
Distance to entry point, Winnipeg (X_4)	0.336*	0.136*	-0.154*	-0.030*
Distance to nearest service centre (X_5)	0.756*	0.140*	0.080*	0.112*
Distance to nearest trail (X_6)	-0.301*	0.297*	0.018*	-0.130*
Distance to nearest railway loading point (X_7)	-	0.109*	0.021*	0.061*

* = significant at the 0.05 level.

the relationship between the independent and dependent variables. Given the proposed hypotheses, all but one of the r values are expected to be positive, thus indicating a positive relationship between the independent and dependent variables. The only anticipated negative r value relates to the relationship between land quality and date of entry. This is not entirely borne out by the results. The results are discussed in Chapter V.

(ii) Order of entry of the independent variables into the regression equations and their contributions to R^2

The independent variables show no consistency in their order of entry into the regression equations representing successive time-periods (Table 23). Two additional points require attention. First, there is a decline in the R^2 value through time from 0.6580 (R=0.8112) for the period ending in 1876 to 0.0818 (R=0.2860) for the period ending in 1891 (Table 23). The high R^2 value for the period between 1872 and 1876 is related to the small number of cases analysed (12). Second, there is a decline in the importance of the distance variables through time and an increase in the importance of the environmental variables of land quality (X_1) and woodland (X_3). This is observed when both the order of entry of the variables into the equations and the contributions of these variables to R^2 are considered. These issues are developed further in Chapter V.

TABLE 23

ORDER OF ENTRY OF THE INDEPENDENT VARIABLES INTO THE REGRESSION EQUATIONS AND THEIR CONTRIBUTIONS TO R^2, 1872-1891

Variable	1872-76 N = 12 Order of Entry	1872-76 N = 12 Contribution to R^2	1877-81 N=160 Order of Entry	1877-81 N=160 Contribution to R^2	1882-86 N=149 Order of Entry	1882-86 N=149 Contribution to R^2	1887-91 N=140 Order of Entry	1887-91 N=140 Contribution to R^2
Land Quality (X_1)	2	0.0647†	6	0.0063†	5	0.0025†	1	0.0403*
Flowing Surface Water (X_2)	4	0.0045†	7	0.0002†	3	0.0126†	-	-
Woodland (X_3)	5	0.0086†	5	0.0107†	4	0.0076†	3	0.0145†
Distance to entry point, Winnipeg (X_4)	3	0.0084†	2	0.0231*	1	0.0236†	-	-
Distance to nearest service centre (X_5)	1	0.5718*	4	0.0097†	2	0.0304*	4	0.0085†
Distance to nearest trail (X_6)	-	-	1	0.0883*	6	0.0025†	2	0.0181†
Distance to nearest railway loading point (X_7)	n i	n i	3	0.0074†	7	0.0007†	5	0.0004†
Total		0.6580†		0.1456*		0.0799†		0.0818*

* = significant at the 0.05 level; † = not significant at the 0.05 level.

- = F-level insufficient for computation; n i = not included in the regression.

CHAPTER V

DISCUSSION AND ASSESSMENT OF THE ANALYSIS OF PROCESS AND FORM

This study adopts a modified process-form approach in the analysis of the evolution of agricultural settlement in southern Manitoba. The settlement process and related forms, the spatial expressions of the process, are analysed for the period between 1872 and 1891. The 461 quarter sections settled by 1891 are analysed by testing the hypotheses incorporated in the process-model. Specifically, these hypotheses test the effect of distance, environmental and region-specific variables on the date of entry of land. The results of the descriptive and stepwise multiple regression analyses, presented in Chapter IV, are discussed and assessed in this chapter. Where appropriate, their economic significance in the agricultural settlement process of the commercially-oriented individual is demonstrated. In particular, the significance of proximity to a railway loading point, the variable initially thought to be most crucial in the settlement process of the study area, is discussed and a counterfactual is employed in this context.

1. Discussion of the Variables in the Settlement Process

The variables incorporated in the settlement process and analysed in relation to spatial form are those determining the economic

attractiveness of a quarter section. The interplay of specific distance and environmental variables that determine the attractiveness of land for settlement is expected to influence the date of settlement. Land of greater economic attractiveness is assumed to be settled before land less attractive for agricultural purposes.

During the twenty-year period analysed the R^2 values change and no single variable consistently accounts for most of the variation in the date of entry. The variation in the order of entry of the independent variables into the regression equations through time is due to the changing relative importance of the variables in the settlement process. Results indicate that the relative significance of distance and environmental variables changes through time, with a decline in the importance of the distance variables, as friction of distance is reduced, and an increase in the importance of the environmental variable, land quality. Although in 1881 all four distance variables are significant in the final regression equation, none of the environmental variables are significant at this date. Land quality, however, having not been significant in the early years of settlement, is the only significant variable in the settlement process by 1891. The increased importance of this variable reflects the fact that, with increasing agricultural commercialisation, greater value is placed on land with superior soil capability for agriculture. These results accord with Gentilcore's (1972) analysis of early agricultural settlement in Ontario. Gentilcore (1972) found that minor environmental variations were largely ignored by the earliest settlers and, even if perceived, were outweighed by other considerations such as accessibility and institutional regulations determining the direction of settlement. Through time, with advances in

technology and increased experience in assessing the agricultural capability of the land and farming, land quality assumed importance. It is probable that land quality needs to be assessed at both a regional and a local scale. At a regional scale the principal environmental variations in the area are important considerations in the settlement process, in contrast to minor variations which are initially of little influence but which gain importance through time. The absence of major environmental variations in the study area precludes any analysis in this study of settlement in relation to environmental variations at the regional scale. It was postulated in the formulated process that, until 1881, the presence of both flowing surface water and woodland in a quarter section would increase the attractiveness of that quarter section relative to land possessing only one or neither of these qualities. Empirical studies suggested that land possessing both flowing surface water and woodland were settled earlier than land without these properties (Morton, 1967; Murchie, 1936; Weir, 1964), but the results do not support this postulate. The results suggest that the presence of these minor environmental characteristics was not a significant consideration in the settler's decision-making process. It is further proposed that empirical analyses have inferred the relevance of these variables in the settlement process from the observation of spatial form characteristics, thereby illustrating one disadvantage of inferring process from static form analysis. The results obtained provide support for the exclusion of these two environmental variables from the formulated process for the period after 1881, for only in 1886 is the presence of one of these variables, woodland, significant in accounting for any variation in the date of entry of land.

Contrary to expectations based on theoretical assumptions which suggest that proximity to a service centre was a major consideration in the location decision-making process, results of the descriptive statistical analysis indicate that most of the land closer to the nearest service centre was not settled at an earlier date than land further away. Results of the regression analysis reveal that some of the variation in the date of entry is accounted for by proximity of the land to the nearest service centre. Through time the partial coefficient of determination, r^2, of this variable declines. On the basis of these results it is suggested that at no time during the period analysed was proximity to a service centre a dominant consideration in the settler's decision-making process. Although land was available close to service centres, it was not consistently settled earlier than land further away. During the first years of settlement it is likely that the settler produced most of his own food requirements, having to make only infrequent journeys to the service centre to obtain more specialised goods. It is suggested that, due to the infrequency of these visits, a close location and consequent minimisation of travel-time was not of importance to the settler in relation to other considerations. As the commercial orientation of agriculture increased between 1872 and 1891, it is likely that settlers placed a higher priority on alternative uses of their time in relation to travel-time to service centres, thereby reducing the assumed advantage of occupying land close to a service centre. It is suggested that during the period analysed all locations were perceived as being "sufficiently" close to centres.

Bylund (1960) proposed that settlers wished to minimise distance to the nearest transport route. Results of this study do not support

this suggestion. In the area of southern Manitoba analysed, all land was located less than fifteen miles from the nearest trail and approximately 67 percent was within five miles of a trail. Results reveal that land closer to the trail was not consistently settled before land further away. During the early 1870s it is likely that the location of trails only directed settlement in a general area and was not influential in the selection of a specific location. Within a general area of at least fifteen miles from a trail, proximity to a trail was not important. During the first years of settlement in particular, use of trails for travel or transport purposes from the farm was of limited significance, since the principal concern of the farmer was to bring his land under cultivation. Even if wood for building or fuel purposes had to be transported to the quarter section, the number of journeys of this type may have been too limited to warrant a location close to a trail. This may have been the case, in particular, if other conditions influencing the attractiveness of land further away were regarded more highly.

Contrary to expectations based on theoretical assumptions, distance to the entry point had no apparent influence on date of settlement through time. The analysis of the variables influencing spatial form does not support the theoretical assertion that there is a positive relationship between date of entry and distance from the entry point. Proximity to Winnipeg is likely to have been important at the time when it was the only major centre in Manitoba, providing both goods and services and possessing an immigration office where foreign settlers destined for western Canada were required to register. By the early 1870s, when the first settlers arrived in the area analysed, several additional

service centres existed in Manitoba. Gladstone and Westbourne, for example, were already in existence in the area analysed, in addition to Portage-la-Prairie which was the largest centre located between those in the area analysed and Winnipeg. These centres provided the goods and services required by the settlers, thereby eliminating the need for a close location to Winnipeg. Registration for land did not need to be at the main Dominion Lands Office in Winnipeg, but could be at a branch office. The realisation that land registration, like immigrant registration, took place only once and thus required no return journey to Winnipeg, further supports the suggestion that proximity to Winnipeg was of nominal importance to the settler locating in the study area during the period analysed. Following railway construction, friction of distance, in terms of the duration of transport and level of freight rates, was reduced still further.

2. The Importance of the Railway in the Settlement Process

Statements such as "nearness to railways and to projected railways was of first importance to the settler" (Mackintosh, 1934, p. 46) and "specialized wheat growing areas develop only near the railway" (Mackintosh, 1934, p. 56) reveal the importance attached to the railway in commercially-oriented agricultural settlement. Much literature relating to prairie settlement has focused upon rates of settlement and the general location of settlement, sometimes relating it to influences external to the region such as the level of agricultural technology and wheat prices at Winnipeg (Norrie, 1975). These studies have predominantly focused upon settlement at the scale of the three prairie provinces of Manitoba, Saskatchewan and Alberta. It is suggested that pat-

terns described in the literature by the phrase "settlement pattern" may be a generalisation, referring qualitatively to its relationship to specific variables. The relationship is borne out only on a regional scale and not on the local scale employed in this study.

Unlike results obtained in Dick's (1980) settlement study, proximity to a railway loading point did not contribute significantly to a variation in date of entry. This result is at variance with other empirical work, also, which assumed the importance of accessibility to the railway to the early settlers (Loveridge, 1977; Mackintosh, 1934) as well as with the theoretical assumption that settlers sought to minimise distance to a communication link (Bylund, 1960). Although this may in part be due to the relative uniform character of the region resulting in limited variation in this variable, it is suggested that conditions in the area analysed between 1872 and 1891 are more likely causes of the results obtained. During the years analysed, agriculture in the study area became increasingly commercial, changing from an essentially subsistence to an essentially commercial nature. It is probable that during this period of agricultural establishment the added advantage of a location close to a railway loading point may not have been widely perceived. Between 1877 and 1881 distance to the nearest railway loading point was significant in accounting for a variation in the date of entry of land. This may reflect the anticipation of and response to the construction of the Canadian Pacific Railway main line which was opened between Portage-la-Prairie and Brandon in 1881. During this sub-period land was available and entered within thirty miles from the nearest loading point. By 1886, following further railway construction, no land was further than twenty miles from a loading point and by

1891 this distance had been further reduced to fifteen miles. It is suggested that, with increased commercialisation of agriculture and the consequent increased use of railway loading points, any land settled within twenty miles of a loading point was considered to be of similar attractiveness in terms of this variable.

Dick (1980) indicated that little attention has been paid to the study of the influence of distance from a railway in the selection of site. Using multiple regression analysis in his quantitative study of the first settlement of the Abernethy district of Saskatchewan, a six-township area, Dick (1980) found that approximately 60 percent of the variation in date of entry was attributable to this distance variable. It is suggested that the reason that distance to a railway may have been the principal consideration in the settler's location choice in Saskatchewan, the North-West Territories in the 1880s, and not in Manitoba is not due to the different degrees of commercial motivation by the pioneer settlers, but rather to the number and type of crops produced. Settlement in Saskatchewan, which began in the early 1880s, followed the construction of the railway and wheat was rapidly established as the dominant crop. The Abernethy settlers intended to specialise in grain farming and "wheat quickly established its economic importance as the principal cash crop in the Abernethy area" (Dick, 1980, p. 78). It is suggested that early settlers in Manitoba, particularly those arriving prior to railway construction, were not dependent on wheat as their principal or only crop, and produced a variety of crops. No published information is available indicating the crops grown and their yields in Manitoba in the 1870s to support or refute this suggestion. A comparison of the yields obtained for different

crops in the province of Manitoba and the Qu'Appelle region of Saskatchewan, in which the Abernethy district is located, is made for 1881. A variety of grain and root crops and legumes were grown in both regions, indicating a diversified agricultural base, characteristic of incipient commercial agriculture. In neither region was wheat the dominant crop at this date. In Manitoba the principal crop grown was oats, whereas for the Qu'Appelle region it was potatoes. By 1885, however, wheat had established itself as the principal crop in the Qu'Appelle region, as it did in Manitoba by 1886. Between 1881 and 1885 the amount of cultivated land devoted to wheat farming in the Qu'Appelle region increased more than four-fold to 38.8 percent of the cultivated land. In comparison, the acreage under this crop in Manitoba only doubled between 1881 and 1886, thereby occupying 48.3 percent of cultivated land. The rapid increase in the wheat acreage in the Qu'Appelle region is significant since it occurs during the period when the first settlers arrived, in contrast to the later period, following railway construction, in Manitoba. This suggests the transition of agriculture from an essentially subsistence to an essentially commercial nature and suggests a realisation of the significance of the availability of railway loading points in this transition. It is suggested that the greater the importance attached by the settler to the production of a commercial economic staple, the greater is the significance of a location close to a railway loading point in contrast to one further away. Although the railway may have been a necessary condition in the settlement process in southern Manitoba, proximity to it was not the only consideration in the settler's locational choice in the area analysed.

3. Counterfactual Settlement

The settlement process is analysed using both descriptive statistics and stepwise multiple regression in order to assess the effect of individual and multiple variables. The effect of specific variables may be further assessed by employing a counterfactual argument which is an approach that has not been used explicitly in the analysis of prairie settlement evolution. Counterfactuals may be used to assess the degree of importance of a causal variable on the resultant settlement form and may, in addition, be used to derive a form from only one variable in order to observe the effect of a single variable. In this study a settlement form is counterfactually derived from a process which assumes proximity to the nearest railway loading point to be the dominant variable. This counterfactual approach is used to assess the impact of this one variable on settlement form. A comparison of the real and counterfactually derived forms indicates the relevance of proximity to the nearest railway loading point in the settlement process.

Proximity to the railway is assumed to have been of importance to early settlers in Manitoba and the prairie region (Friesen, 1963-64; Mackintosh, 1934; Weir, 1960-61, 1964). In the area analysed, comprising fifty-six townships, 2016 square miles, no settlement form is revealed indicating that settlers elected to locate in available quarter sections minimising distance to loading points and thereby forming belts of settlement along the railway lines (Figure 5). Figure 10 demonstrates what the settlement form might have been like had distance to the nearest railway loading point been the dominant variable in the settlement process and thus available land closest to the loading points had been entered first. In Figure 10 the actual settlement locations

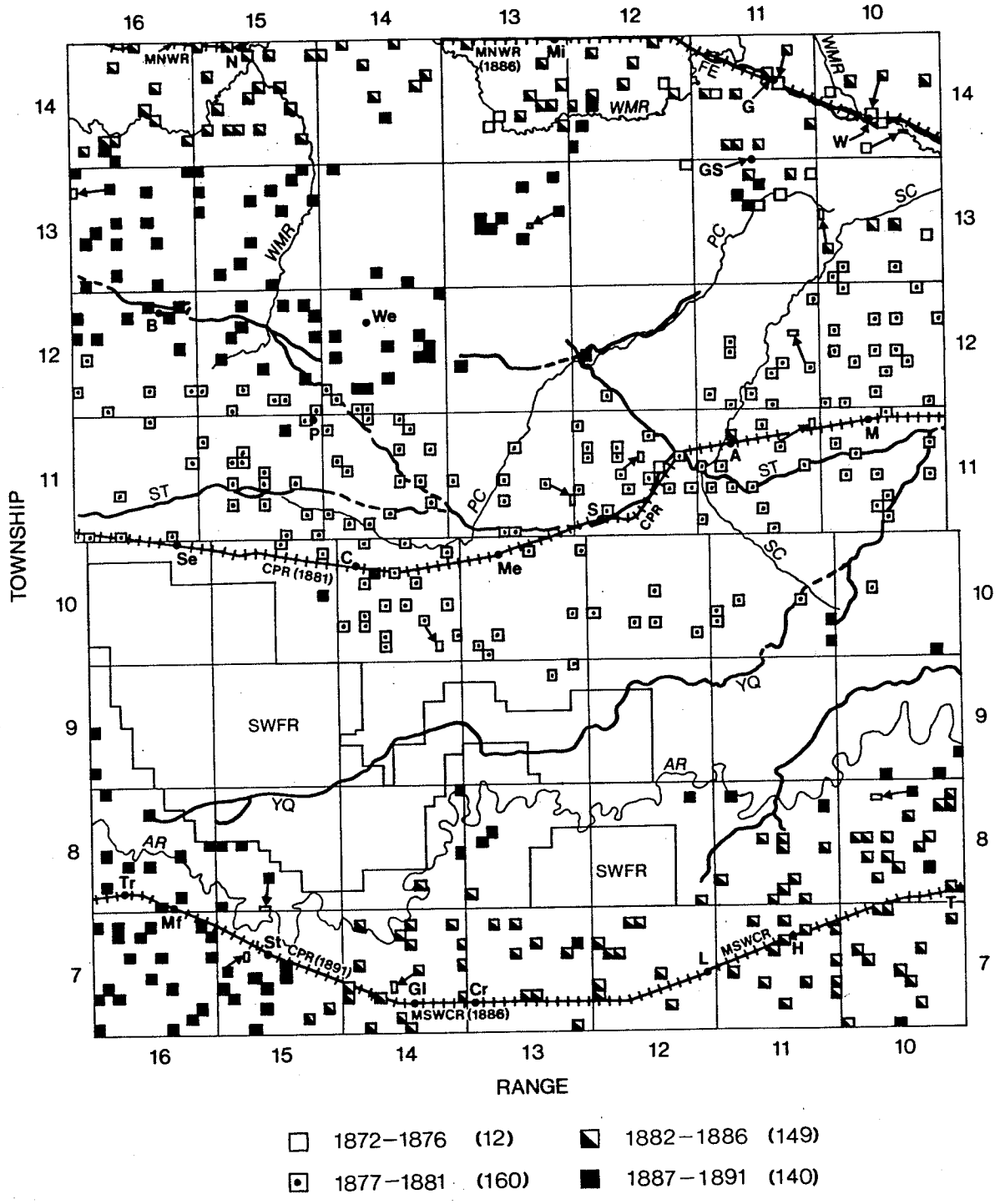


Figure 10. Real and Counterfactual Settlement in Relation to Distance to the Nearest Railway Loading Point, 1872-1891

are illustrated for the period between 1872 and 1876, whereas the quarter sections occupied between 1877 and 1891 are counterfactually derived. The difference between the actual and counterfactually derived settlement forms (respectively Figures 5 and 10) is apparent. The former reveals no distinct pattern, whereas the latter follows the railway lines. These results confirm the results obtained in the regression analysis, namely that proximity to the nearest railway loading point was not the dominant variable influencing settlement form. Rather, several interacting variables, including the railway variable, were responsible for the resulting forms. Mackintosh (1934) stated that twelve to fifteen miles was the economic distance for hauling grain in the early twentieth century but, on the basis of the results obtained in this study, twenty miles is suggested to be the economic distance for hauling agricultural produce in this agricultural area of southern Manitoba in the period analysed. It is proposed that during the early years of settlement the time taken to transport grain to the loading point on the railway line may not have been of importance to the settler in relation to alternative uses of his time, whereas the income from the grain was important. During the time-period analysed no added advantage of the proximity to railway loading points appears to have been perceived. Within an area less than twenty miles from a loading point a close location does not appear to have been considered important. The individual may have initially located only within a general area within twenty miles of the loading point, considering the distance to the loading point as only one of a number of factors influencing his choice of location. The general statements made in regional-scale studies cannot be applied unquestionably to studies relating to a local scale.

4. The Significance of the Cost of Land in the Agricultural Settlement Process

The process formulated in this study incorporates distance and environmental variables of universal applicability. Their selection has a sound basis in theory and they have been shown to be of importance in the first agricultural settlement of both the Prairies and other pioneer regions. In addition to these universally applicable variables, certain variables may be region-specific, being relevant in particular to the settlement of the region analysed. Loveridge (1977) suggested that the grant type of a quarter section was not a consideration in the settler's location decision-making process, other than in terms of its cost. The descriptive analysis indicates that homestead lands were, on average, settled earlier than lands that had to be purchased. It is suggested that the cost of land of different grant types influenced the date of settlement of land in the area analysed. This is based on the fact that lands of a specific type were, on average, settled earlier than lands of other types. The cost of land is thus a region-specific variable. It is an institutional variable since the Dominion was responsible for allocating land to different grants and for determining the price of Dominion lands.

It is suggested that the cost of land may have formed a deterrent to settling close to the railway line or projected line. Until 1881 the exact location of the transcontinental railway across the area analysed was uncertain. Information regarding the cost of land is derived from Tyman (1972). On July 9, 1879, five belts were drawn up by the government on either side of the projected railway line which was assumed to take a route approximately twelve miles north of the Canadian

Pacific Railway main line as constructed in 1881 (Tyman, 1972) (Figure 2). Within each of these belts the price per acre of land was as indicated in Table 24. On May 25, 1881, further modifications were enforced. Regulations determined that all Canadian Pacific Railway land (odd-numbered sections) within the 48-mile belt, that is, 24 miles on either side of the main line, be priced at $2.50 per acre, regardless of its location within the belt, as was Dominion land on even-numbered sections.

The period of analysis from 1877 to 1881 encompasses all three of these regulations. Settlement analysed in 1881 reflects the total number of quarter sections entered between 1877 and 1881 (160). It is suggested that settlers who located more than five miles from the proposed main line, even though land was available closer to the line, may have entered land in the period when land within five miles of the line cost $6.00 or $5.00 per acre, as opposed to the reduced costs at greater distances. A visual appraisal of Figures 5, 6 and 8 together does not suggest a preference for quarter sections of a particular grant type entered at a distance greater than five miles from the proposed railway line. It is proposed that, in the period analysed, settlers placed a greater value on the lower-priced land at a greater distance from the railway, than on a more economic, higher-priced location near the railway, all other variables being equal. It is suggested that the cost of land is a variable relevant in the settlement process of southern Manitoba. It is a region-specific variable that is likely to be of relevance in the evolution of settlement throughout North America where a land-granting system operated with land grants having differential costs. It is further proposed that this variable be incorporated into rural settlement theory.

TABLE 24

PRICE OF LAND WITHIN THE ZONE OF RAILWAY LANDS,

JULY 9, 1879

Belt	Distance From Railway Line (miles)	Price of Railway Land (per acre)	Price of Dominion Land (per acre)
A	0- 5	$6.00	$6.00
B	6- 20	$5.00	$2.50
C	21- 40	$3.50	$2.50
D	41- 60	$2.00	$2.00
E	61-110	$1.00	$1.00

Regulations of October 14, 1879, resulted in an alteration of these prices as presented in Table 25.

TABLE 25

CHANGE IN PRICE OF LAND WITHIN THE ZONE

OF RAILWAY LANDS, OCTOBER 14, 1879

Belt	Railway Land (per acre)	Dominion Land (per acre)
A	from $6.00 to $5.00	from $6.00 to $2.50
B	from $5.00 to $4.00	remained at $2.50
C	from $3.50 to $3.00	remained at $2.50
D	remained at $2.00	remained at $2.00
E	remained at $1.00	remained at $1.00

5. Assessment of the Process

It is argued in this study that individual settlers in the study area were commercially-motivated from their first days of settlement even though located distant from major markets. Surveyors' reports of the area, indicating the suitability of land for wheat cultivation, that is, the cultivation of a commercial rather than a subsistence crop, lends support to this suggestion. Initially the market for agricultural produce was the local non-agricultural population, but commercialisation became realised with developments in transport facilities, notably the railway, and developments in agricultural technology. The study period is one characterised by incipient commercial agricultural enterprises, possibly following a very short phase of subsistence farming. Results obtained support this notion, indicating that during the first years of settlement, when new land was being brought under cultivation, the economic variables in the settlement process relating to commercial farming were of limited significance in determining settlement location. In the 1870s and early 1880s proximity to railway loading points, which provided access to more distant markets, and land quality do not appear to have been important. Towards the latter years of the study period these variables gain in importance in accounting for the variation in date of entry of land, thereby suggesting an increasing commercial orientation of settlers. This indicates that the process which, by definition, operates through time, does not consist of a set of unchanging variables.

A hypothesised settlement process was assumed to contain only distance and environmental variables, relating to accessibility and land quality, if it is to be generally applicable. Additional variables

relating to the presence of specific, minor, environmental features, institutional considerations affecting settlement form, and the presence of earlier settlers, for example, are location and region-specific. Further, individual location decisions are influenced by the ethnic background, agricultural experience and aspirations of the settler and may or may not be based on rational economic judgement. These considerations are settler-specific.

The most striking feature of the results of the process-form analysis of agricultural settlement in southern Manitoba is the lack of significant variables in the settlement process for the period between 1872 and 1891. This is contradictory to much work on rural settlement both in the prairie region and elsewhere and raises some interesting questions about existing rural settlement theory and previous empirical studies. The object of using settlement theory in an analysis of settlement is to explain real-world settlement location. The development of rural settlement theory has been limited and few studies have specifically tested the hypotheses incorporated in settlement theory. While propositions incorporated in theory are assumed to be generally applicable for a frontier region experiencing first settlement, the results of this study do not confirm this without some modification. This is significant, particularly given the fact that hypotheses in rural settlement theory were tested and verified in an area comparable to the study area (Hudson, 1969). This prompts the question whether existing rural settlement theory is indeed generally applicable. Until more empirical studies of settlement evolution are made which specifically test theory this question remains unanswered.

The results obtained confirm the value of adopting a process-form approach in the study of settlement evolution. Many, essentially qualitative, empirical studies of western Canadian settlement have adopted an inferential approach, inferring the significance of specific variables in the settlement process from static form analysis. It is noted that the settlement location decision-making process is highly complex. The proposed settlement process is eminently reasonable on the basis of theory and empirical studies and is suggested to be operating at different scales, consisting of both local and regional influences. The results suggest that not one of the economic variables was considered of overriding importance in the settlement process postulated to be operating between 1872 and 1891 in the area of southern Manitoba analysed, as was the case of proximity to the railway line in Dick's (1980) study. All variables are undoubtedly relevant in the process. They are crucial a priori and are similar within the area. The results indicate that the location decision-making process includes, in addition to distance and environmental variables, the consideration of either settler-specific, location-specific or region-specific variables, or a combination of these three types of variables. Within the area considered details of the analysis demonstrate that the variables are of uniform relevance spatially.

CHAPTER VI

CONCLUSION

In the period from 1872 to 1891 agricultural settlement in southern Manitoba became established. Agricultural settlement evolution is a component of the economic development of the region and is analysed in this study using a process-form approach. This approach assumes the formulation of a settlement process incorporating variables derived from rural settlement theory and empirical rural settlement studies. The analysis of the process and related forms is presented in order to assess the effect of the incorporated variables on the date of entry of land. Few analyses of settlement have specifically tested a settlement model with reality.

1. Summary of the Thesis

Three aims were outlined in order to attempt an explanation of the agricultural settlement evolution in an area of southern Manitoba between 1872 and 1891. The first aim was to formulate an appropriate settlement process. The second aim was to isolate and assess the importance of the principal variables in the process and the third aim was to analyse the settlement forms between 1872 and 1891 in relation to the process.

The attractiveness of a quarter section for settlement is assumed to be a function of specific eonomic variables based on measures of distance and the environment. For this reason the hypothesised settlement process incorporates relevant distance and environmental variables. Four distance variables are considered. These relate to the distance of the quarter section to the entry point, Winnipeg, the nearest service centre, railway loading point and trail. The three environmental variables considered relate to land quality and the presence or absence of flowing surface water and woodland. In order to take account of changing conditions in southern Manitoba between 1872 and 1891, modifications in the settlement process are required. For this reason the settlement process is analysed in four five-year periods, ending in 1876, 1881, 1886 and 1891. The process is analysed in two parts. First, hypotheses incorporated in the model are tested using descriptive statistics in order to determine the effect of individual variables in isolation on the date of entry of land and, thus, on settlement form. Second, stepwise multiple regression analysis is employed in order to test the combined effect and relative importance of the variables. One thousand quarter sections in the study area are selected using a basic random sampling procedure. Between 1872 and 1891, 461 quarter sections in this sample had been settled. Analysis is confined to these 461 locations.

Until the early 1870s migration to western Canada was limited. The first two quarter sections in the sample to be entered were occupied in 1872 and the largest number of entries to be made in any one five-year period between 1872 and 1891 occurred between 1877 and 1881. During this period 160 individuals settled in the area. The fact that

only 461 quarter sections in the selected sample were entered by 1891 indicates that, although agricultural settlement was well established by this date, the period of settlement evolution was not complete and much land was still unoccupied. It is argued that the selection of a specific quarter section for settlement, and hence date of settlement, was determined by the availability of land for settlement and was further a response to the economic attractiveness of that quarter section. Attractiveness changed through time and was the result of the interaction of the economic variables in the process. Results of the regression analysis reveal that between 1872 and 1891 no single variable consistently accounted for most of the variation in the date of entry of land. During this period the relative importance of the variables changed. This is revealed by the changing order of entry of the independent variables into the regression equations. Between 1872 and 1891 there is a decline in the importance of the distance variables and an increase in the importance of the environmental variable, land quality, in the location decision-making process. This is interpreted as reflecting the increased commercial agricultural motivation of the settlers in the area towards the latter years of the study period and accords with findings of a study of early agricultural settlement in Ontario (Gentilcore, 1972). During the years analysed, agriculture in the study area became increasingly commercial and wheat occupied over twice the acreage of cultivated land in Manitoba in 1886 as it had done in 1881. As early as 1876 some wheat was exported from Manitoba and in the 1880s grain elevators and flat loading platforms were constructed at railway stations, thereby providing facilities for transporting agricultural produce, such as wheat, out of the region. For the period anal-

ysed, results suggest that, within twenty miles of a railway loading point, no added advantage was perceived to locating closer to a loading point in preference to locating further away. Proximity to a railway loading point was but one of several considerations in a settler's location choice. The settlement process is highly complex involving, in addition to distance and environmental considerations, settler-specific, location-specific and region-specific considerations. It is suggested that an additional economic, region-specific, variable be considered in the settlement process of southern Manitoba, namely the cost of land. This variable is related to grant type since prices per acre varied for land of different grant types. It has been noted that the disposition of a quarter section was not a consideration in the settler's decision-making process, other than in the cost of its acquisition (Loveridge, 1977). Free homestead lands in the study area were settled before lands that had to be purchased and it is further suggested that the cost of land may have formed a deterrent to settling close to a railway line or projected line between 1879 and 1881 when the price of land increased with distance to the railway line.

A major achievement of this thesis is the explicit recognition that established rural settlement theory is not necessarily appropriate to detailed empirical analysis. For this area of southern Manitoba between 1872 and 1891 it is clearly demonstrated that conventional variables are inadequate as explanations of settlement form. A second major achievement is the recognition that empirical generalisations relating to rural settlement in both Manitoba and the prairie region, which were assumed to be applicable, are inappropriate to the study area (Mackintosh, 1934; Morton, 1967; Richtik, 1971; Weir, 1964). Further to Grossman's

(1971) criticisms of Hudson's (1969) work, who argued that Hudson failed to derive general "laws" of settlement, it is suggested, on the basis of results obtained in this study, that the propositions incorporated in theory are not generally applicable without modification to a frontier region experiencing first settlement. Results reported offer some support for Grossman's (1971) criticisms in that the variables do not provide a full explanation. The reasons for this are not entirely clear but are related to the specific character of the area at the time analysed and the characteristics of the settlers. Results obtained in both Grossman's (1971) study and this analysis of agricultural settlement evolution suggest that institutional influences on settlement are significant. In order to improve existing rural settlement theory it is proposed that the institutional variable, cost of land, be incorporated if theory is to be generally applicable to the North American settlement situation.

2. Limitations of the Study

A process-form approach is highly suited to the analysis of settlement evolution. A process is formulated and analysed in order to identify the possible variables responsible for the observed settlement form, since an analysis of form alone introduces the inference problem, inferring processes from known forms. This process-form approach inevitably has some deficiencies which stem chiefly from the simplifying assumptions made in data collection and process formulation. Assumptions made in data collection are related, in particular, to the calculation of specific measures of distance and the environment. Thus, since the exact locations of homesteads are unknown and knowledge of

the exact location of some of the major trails is uncertain, straight-line distance measures are taken from the centre of quarter sections. A linear relationship is assumed between date of entry and the distance variables. Although the precise nature of the relationship is not known, it has been suggested to be a Pareto function (Morrill, 1963). Information regarding the earliest year in which a centre is known to have been in existence is obtained from a variety of primary and secondary sources. It is noted that centres are assumed to have provided at least basic goods and may have been in existence prior to the date considered in this study. Thus, their possible existence in the years prior to the one assumed may have contributed to the locational considerations of those settlers arriving prior to that year. Environmental information is obtained from surveyors' township diagrams, field notes and reports but these documents do not provide an accurate, consistent and extensive record of environmental conditions. The survey was made only along the boundary of quarter sections and only infrequently did the surveyor provide environmental details about the interior character of quarter sections. In this study any mention of woodland in these documents is assumed to indicate the presence of wood suitable for building and fuel purposes, regardless of tree-type and quantity. The indication of the presence of any form of flowing surface water is assumed to reflect the presence of a continuous supply of potable water. Although these documents provide somewhat unreliable information, they are the only source of contemporary information relating to environmental conditions. The year of entry is assumed to be the first year in which land was settled. Thus, no pre-survey settlement is considered. The settler is further assumed to be a rational economic

man, aware of all factors influencing the economic attractiveness of a quarter section and seeking a location to maximise economic opportunity.

In addition to these limitations relating to the making of assumptions, the process-model is unable to distinguish the sensitivity of individual variables, that is, the effect of change in other variables on the variable being considered. Finally, since the model is a simplification of the settlement process, local and minor variables accounting for any variation in the date of entry of land are not considered. Notwithstanding these limitations relating mainly to the paucity of more detailed data for the period analysed, the validity of the process is upheld and a process-form approach to the study of agricultural settlement evolution in southern Manitoba thus constitutes a valid research theme.

3. Suggestions for Further Research

Many studies in historical geography have characteristically been descriptive accounts of distributions of phenomena in space, where cross-sections of the past were reconstructed using historical records. Neither a single cross-section nor a set of chronologically-arranged cross-sections provides an explanation of changes in the landscape. Clark (1960) argued in favour of the geography of change, thereby incorporating a temporal component into the study of landscape change. Clark (1954) believed that, in order to be able to explain a given situation, it was necessary to study its generating processes. A development of this change through time approach suggested by Clark (1954) is the study of the evolution of spatial form. This approach provides a means of incorporating a temporal and explanatory component into the analysis

of settlement and is achieved by employing a process-form approach. The analysis of processes is a research theme in current human geography and the need to study the processes generating spatial form has been advocated (Amedeo and Golledge, 1975). Historical geographical studies may profitably adopt such an approach to the study of spatial evolution, thereby incorporating both a temporal and an explanatory element into the analysis. The inference of a process from an analysis of form is an unsatisfactory means of explaining form since it may result from one of a number of processes. Explanation may more satisfactorily be achieved by deducing form from a hypothesised process. A process may be operationalised to generate a number of forms by adopting a simulation procedure. This is a means of gaining a greater understanding of landscape evolution and, by incorporating a chance element, the probabilistic process becomes more realistic of human behaviour. Additional insight may be gained into human behaviour in the past by analysing counterfactuals.

In this study of spatial form evolution a modified process-form procedure is used. A settlement process is formulated and the effect of the variables is analysed. In this study the terms "process" and "form" are defined as follows. The term "process" refers to a succession of actions of interacting variables which result continuously in an outcome and the term "form" refers to the spatial outcome at any one point in time resulting from a particular process. Analysis of the process comprises the use of descriptive statistics and stepwise multiple regression, and a simple counterfactual is employed to demonstrate the impact of one variable on date of settlement. Hypotheses derived from theory and empirical settlement studies are tested to determine the

effects of the variables on date of entry of the quarter sections analysed.

Several directions for further research are indicated relating to both the subject matter of this study and to the possibility of adopting a process-form approach to other research areas in historical geography. A further means by which settlement evolution may be analysed is by the generation of spatial forms from a hypothesised process. Simulation is the means by which the process may be operationalised. Settlement forms may be generated by calculating an attractiveness value for each quarter section analysed on the basis of distance and environmental variables in the model. Subsequently, the appropriate number of settlers that actually entered land during the period analysed are located on available lands with the highest attractiveness values. By amending the formulation of the settlement process it is possible to observe the effect that alternative location decisions would have had, thereby providing a greater understanding of what actually occurred. Counterfactual assertions may be used, first, to alter the settlement process and, second, to alter conditions relevant to the region. For example, it may be desired to examine the effect of the railway variable on form. This would require its removal from the process. When compared with the real-world form this generated form may reveal the importance or lack of importance of the variable in the process. Alternatively, it may be desired to observe the effect which the alternative route of the Canadian Pacific Railway main line may have had on settlement if it had taken the route as originally surveyed. Consideration of these "might-have-beens" would provide a greater understanding of both the generating process and the real form.

Another research area in historical geography where a process-form approach may be usefully adopted to aid explanation is in the analysis of agricultural evolution. An evolutionary analysis of land use, using a process-form procedure, may be employed to study the transition of an agricultural economy from an essentially subsistence to an essentially commercial nature. Through time agriculture is expected to develop from a diversified base to a specialised base. Such a land use evolutionary study, when combined with an agricultural settlement evolutionary study, would present insight into a significant part of the development of the economic landscape. A process-form methodology thus constitutes a valid research theme for historical geographical studies concerned with dynamic explanatory analyses. Analyses adopting this approach might contribute to the rewriting of rural settlement theory.

APPENDIX

DATA SOURCES

1. Archival and Unpublished Materials

Brandon, Manitoba. Land Titles' Office.
Abstract Books: Hudson's Bay Company land sales records.

Calgary, Alberta. Archives, Glenbow-Alberta Institute.
Canadian Pacific Railway Company: Land Examination Papers (land descriptions), Land Grant Records, Land Sales Records (vols. 22, 30, 61, 64, 70, 72, 73, 75-83, 106-109, 125, 127, 128), Town Lot Contract Books.

Einarson, N. File containing unpublished information on early grain elevators in Manitoba.
Winnipeg: Historic Resources of Manitoba.

Letourneau, J.A.R. 1974. "Manitoba's Railways - A Pilot Study."
Winnipeg: Historic Resources of Manitoba.

Montreal, Quebec. 1980. Construction history of the Manitoba and North Western Railway line - personal communication with O. Lavallée, Archivist, Canadian Pacific Archives.

Morden, Manitoba. Land Titles' Office.
Abstract Books: Hudson's Bay Company land sales records.

Munroe, L. 1959. "Outline of History of the Company's Land Grants."
Calgary: C.P.R., Department of Natural Resources. Held at the Archives, Glenbow-Alberta Institute.

Neepawa, Manitoba. Land Titles' Office.
Abstract Books: Hudson's Bay Company land sales records.

Ottawa, Ontario. Public Archives of Canada.
Construction history of the Portage, Westbourne and North Western Railway line between Portage-la-Prairie and Minnedosa: Department of Transport, RG12, vol. 1851, file 3268-15 pts. 2 and 3.

Portage-la-Prairie, Manitoba. Land Titles' Office.
Abstract Books: Hudson's Bay Company land sales records.

Winnipeg, Manitoba. Crown Lands Branch, Department of Mines and Natural Resources.
Township General Registers for Townships 7 to 14, Ranges 10 to 16, west of the Principal Meridian.

Winnipeg, Manitoba. Surveys Branch, Department of Mines and Natural Resources.
Field Notes and Reports of the Dominion Lands Survey and Township Diagrams of Townships 7 to 14, Ranges 10 to 16, west of the Principal Meridian.

2. Maps, Atlases and Plans

Canada. 1966. Department of Agriculture. Canada Land Inventory. Soil Capability for Agriculture: Brandon map sheet 62G. Ottawa: Queen's Printer.

Canada. 1966. Department of Agriculture. Canada Land Inventory. Soil Capability for Agriculture: Neepawa map sheet 62J. Ottawa: Queen's Printer.

Canada. 1964. Surveys and Mapping Branch, Department of Energy, Mines and Resources. Topographic map, 1:250,000. Brandon map sheet 62G.

Canada. 1964. Surveys and Mapping Branch, Department of Energy, Mines and Resources. Topographic map, 1:250,000. Neepawa map sheet 62J.

Canada. 1977. Surveys and Mapping Branch, Department of Energy, Mines and Resources. Topographic map, 1:250,000. Winnipeg map sheet 62H.

Dominion of Canada Atlas. 1875. n.p.

Morden, Manitoba. Land Titles' Office.
Relevant town plans.

Neepawa, Manitoba. Land Titles' Office.
Relevant town plans.

Weir, T.R. (ed.). 1960. Economic Atlas of Manitoba. Winnipeg: Stovel Advocate Press, Ltd.

Winnipeg, Manitoba. Land Titles' Office.
Relevant town plans.

Winnipeg, Manitoba. Provincial Archives of Manitoba.
Contemporary maps depicting the area of southern Manitoba analysed.
Map of Province of Manitoba, Feb., 1871.
Manitoba Surveys effected, 1871.

Townships Surveyed in Manitoba and the North-West Territories, 1878.
Canada. Manitoba and North-West Territories, c. 1880.
Province of Manitoba, 1881.
Map of Province of Manitoba, Canada, 1882.
Canadian Pacific Railway Lands, 1886.
Railway and Guide Map of Manitoba, 1887.
Indexed Railway and Guide Map of Manitoba, 1889.
Map of Manitoba, 1891.

Winnipeg, Manitoba. Surveys Branch, Department of Mines and Natural Resources.
Railway and Trail Plans, also depicting the location of service centres.
Canadian Pacific Railway - main line. Surveys Branch No.: 1881, 2965.

Canadian Pacific Railway - Souris Branch.	2994
Manitoba and North Western Railway.	2052, 2070
Manitoba South Western Colonization Railway.	2969, 2990
Fort Ellice Trail.	2526

3. Public Documents

Canada. Census of Canada, 1880-81. 3 vols.
Ottawa: Maclean, Roger and Co., 1882-84.

Census of the Three Provisional Districts of the North-West Territories, 1884-85.
Ottawa: Maclean, Roger and Co., 1886.

Census of Manitoba, 1885-86.
Ottawa: Maclean, Roger and Co., 1886.

Census of Canada, 1890-91. 4 vols.
Ottawa: Dawson, 1893-97.

Canada. House of Commons. Journals.
Publicity about Manitoba, movement to Manitoba.
37 Vic. (1874) vol. 8, app. 7.

Canada. Parliament. Sessional Papers.
Publicity about Manitoba, cost of transport and movement to Manitoba, land guide service, immigration and population figures for Manitoba.

36 Vic. (1873) no. 26	46 Vic. (1883) no. 14
37 Vic. (1874) no. 9	47 Vic. (1884) no. 14
38 Vic. (1875) no. 40	48 Vic. (1885) no. 8
39 Vic. (1876) no. 8	49 Vic. (1886) no. 9
40 Vic. (1877) no. 8	50 Vic. (1887) no. 12
41 Vic. (1878) no. 9	51 Vic. (1888) no. 4
42 Vic. (1879) no. 9	52 Vic. (1889) no. 5

43 Vic. (1880) no. 10
44 Vic. (1881) no. 12
45 Vic. (1882) no. 11
53 Vic. (1890) no. 6
54 Vic. (1891) no. 6
55 Vic. (1892) no. 7

Canada. Statutes.
Boundaries of Manitoba.
33 Vic. (1870) c. 3 (Manitoba Act)
40 Vic. (1877) c. 6
44 Vic. (1881) c. 14

Dominion Lands Act.
35 Vic. (1872) c. 23

Railways.
35 Vic. (1872) c. 71 (Canadian Pacific Railway Act)
44 Vic. (1881) c. 1 (Charter of the Canadian Pacific Railway)
45 Vic. (1882) c. 80 (Portage, Westbourne and North West Railway Company)
47 Vic. (1884) c. 73 (Lease of the Manitoba South Western Colonization Railway to the Canadian Pacific Railway)

Canada. Parliament. Privy Council Order.
School lands sale by public auction.
Privy Council Order No. 2432-1887, Ref. 164,161 on 146,365.

Manitoba. Statutes.
Westbourne and North Western Railway Company.
43 Vic. (1880) c. 35.

4. Books, Articles and Newspapers

Bladen, M.L. 1932. "Construction of Railways in Canada to the Year 1885." Contributions to Canadian Economics, 5: 43-60.

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Held at the Archives, Glenbow-Alberta Institute.

Henderson's Directories:

Manitoba Directory for 1876-77. 1876. St. Boniface: La Rivière and Gauvin.

Henderson's Directory of the City of Winnipeg and Incorporated Towns of Manitoba, 1881. n.d. Winnipeg: n.p.

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