INTRA-URBAN MOBILITY IN WINNIPEG

A Study of Geographic Elements

A Thesis

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To my parents

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Preface

Intra-urban migration involves the change of residence within an urban area. It indirectly causes the growth of an urban area through the addition of new residences at the periphery. The majority of studies published focussed on the socio-economic factors as related to the migrants and the spatial distribution of the destinations chosen is largely neglected. It is the purpose of the present study to look into the geographic elements associated with the origins and destinations of residential move.

A move in space involves two points, the origin and the destination. The distribution of these points can be analysed by a number of methods, for example, the nearest neighbor and quadrat methods. Centrographic measures are used because it is not only necessary to determine the distribution of the destinations in relation to the origins but also in relation to the CBD. This last condition is achieved by the rotation and translation of the axes. This procedure enables conclusions to be made with regard to the orientation of the moves, either towards or away from the CBD. Furthermore, the distribution of the points is approximated as close as possible by the standard ellipse through the rotation of the major axis. The standard ellipses for the origins and destinations are compared for their similarities and differences in the location of the mean centers, the coefficients of circularity, and the standard radii. The standard ellipses for the transformed data sets are calculated to determine the sectoral, distance, and direction biases. However, conclusions drawn from the standard ellipses have to be made very carefully because of the inherent shortcomings of the centrographic measures.

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CHAPTER I

INTRODUCTION 1

A Review of Literature

Migration is a process by which a person moves from one point to another point in space. This process takes many forms, one of which is an intra-urban migration. Intra-urban migration involves the change of residence within an urban area. Two most frequently asked questions about this form of migration are firstly, why do people exchange one residence for another, and secondly where and in what direction do the migrants move. Much research has been done in order to answer these questions. The purpose of this chapter is to review the published research on intra-urban migration.

A survey type study is the logical first step to answer the questions concerning intra-urban migration. Examples of this type of study are Rossi's study of Philadelphia and Heiges' study of Seattle.[1] These studies have identified several factors which are found to be

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[1] P. H. Rossi, Why Families Move. A Study in the Social Psychology of Urban Residential Mobility. (Glencoe, Free Press, 1955).

H. E. Heiges, "Intra-urban Residential Movement in Seattle 1962-1967." (Unpublished Ph. D. Thesis, Department of Geography, University of Washington, 1968.) This is a survey type study using pre-existing data.

related to the propensity to move. These factors are life cycle change, change in social or economic status, dissatisfaction with the dwelling unit and the neighborhood which are interrelated. As a family proceeds through its life cycle, there will be a change in space requirements and a change in social and/or economic status. The changes in these factors usually lead to a dissatisfaction with the dwelling unit and with the neighborhood. It may also be possible that the structure of the dwelling unit may deteriorate and the social and racial and/or ethnic structure of the neighborhood may change so that the household would find it undesirable to remain.

The factors affecting residential mobility have been incorporated into ecological models. According to Moore,[2] ecological models are used in the study of intra-urban migration in two contexts :

> "to identify regularities such that short-run predictions of the distribution of these [mobility] rates can be made, and to provide insights into the relationships between selected socio-economic, demographic, and housing variables characterizing the urban environment and the mobility rates which are considered to represent one response to that environment."[3]

The "selected socio-economic, demographic, and housing variables" are variables that measure the differences in

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[2] E. G. Moore, "Comments on the Use of Ecological Models in the Study of Residential Mobility in the City." Economic Geography, Vol. 47 (1971), 73-85.

[3] Ibid., p. 73.

life cycle, social and economic status and the environmental characteristics. These variables are often chosen by researchers utilizing the results of empirical studies.[4] Their effects on the migration rates or rates of population turnover as well as their interrelationships are hypothesized and then tested by using partial correlation.[5] The estimated results do not correspond closely with the observed results. To overcome this problem, Brown and Longbrake[6] constructed their ecological model in a different manner. Instead of specifying the varialbes that are assumed to be influential on the migration rates, the migration rates are considered functions of the scores of each zone on the five components.[7] Multiple stepwise

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[4] See E. G. Moore, "Structure of Intra-urban Movement Rates : An Ecological Model." Urban Studies, Vol. 6 (1969), 17-33.

[5] Ibid., $M_i = f(X_1, X_2, X_3, X_4, X_5)$ where M_i is the rate of population turnover and X_i is the variable affecting the rate of population turnover. Partial correlation technique is used to determine how two variables affect each other while holding a third one constant. This third variable affects both the first and second variable.

[6] L. A. Brown and D. B. Longbrake, "Migration Flows in Intra-urban Space : Place Utility Considerations." Annals of the Association of American Geographers, Vol. 60 (1970), 368-384.

[7] Ibid., p. 377-380. Through principal components analysis, forty-eight socio-economic variables are grouped into five components which are family status, housing quality, income differentials or economic status, residential density and selective stability. The model is in the form of : $M_i = f(C_{i1}, C_{i2}, C_{i3}, C_{i4}, C_{i5})$ where M_i is is the percent of in or out migration and C_{ij} is zone i's score on component j.

regression is then used to identify the effects of each of the components on migration.

The location of the new residence reveals as much about the migrants as the reasons for moving because the characteristics of the new residence and its neighborhood disclose the preference of the migrants. Between the original and the new residence, there are two geometric attributes, which are the distance between them and their direction from each other. However, for some unknown reasons the distance of migration has always received more attention than the direction of migration.

In the study of long-distance migration, it has been found that the probability of finding a migrant at a location depends on the distance of this location from the migrant's initial location. This is so because the longer the distance the lesser are the chances that the migrant would have knowledge about this location. As a result, distance decay functions have been fitted to migration distances. These are the normal, lognormal, exponential, Pareto or gravity logarithmic, gamma, and the Pareto-exponential functions.[8] The normal and lognormal functions are not considered appropriate because the distribution of population is rarely random and not every location has an equal chance of being known to a migrant. The

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[8] R. L. Morrill, "The Distribution of Migration Distances." Regional Science Association, Papers, Vol. 11 (1963), 75-84.

gamma function involves complicated calculations and is therefore not usually used. The Pareto function employs the gravitational concept and is an appropriate function for purposeful moves. But it identifies, rather than explains, the relation between migration and distance, and describes macro-behavior.[9]

The exponential and Pareto-exponential function are considered the best fit for migration distance, the former function for migration and marriage distances and the latter for contacts not involving permanent and costly moves.[10] Besides the work of Morrill and Pitts, Wolpert[11] has used exponential distance to analyse the distance bias of inter-metropolitan migration. There has been no attempt to fit a function of these two forms to the migration distances in the intra-urban context. However, the distance decay functions have been incorporated into the operational models.

All the previous research, whether utilizing empirical, ecological, or distance decay models, neglect the

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[9] Ibid., p. 82.

[10] R. L. Morrill and F. R. Pitts, "Marriage, Migration, and the Mean Information Field : A Study in Uniqueness and Generalities." Annals of the Association of American Geographers, Vol. 57 (1967), 401-422.

[11] J. Wolpert, "Distance and Directional Bias in Inter-urban Migratory Streams." Annals of the Association of American Geographers, Vol. 57 (1967), 605-616.

behavioral parameters of the migrants. Wolpert[12] first identifies the behavioral parameters which are relevant to migration studies. They are place utility and action space.

Place utility is "the net composite utilities which are derived from the individual's integration at some position in space,"[13] or "the measure of attractiveness or unattractiveness of an area relative to alternate locations, as perceived by the individual decision maker, and as evaluated according to his particular needs."[14] The place utility concept is relevant to intra-urban migration in both the decision to relocate and the choice of where to relocate.[15]

A household changes its residence when the present residence no longer satisfies its needs and is therefore unattractive. This can occur when the requirements of space change with an increase or decrease in the household size, or when the household's socio-economic status changes, or when the dwelling unit deteriorates and/or when the neighborhood characteristics alter. In short, the objective place utility no longer matches with the aspired

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[12] J. Wolpert, "Behavioral Aspects of the Decision to Migrate." <u>Regional Science Association</u>, <u>Papers</u>, Vol. 15 (1965), 159-169.

[13] <u>Ibid</u>., p. 162.

[14] J. W. Simmons, "Changing Residences in the City : A Review of Intra-urban Mobility." <u>Geographical Review</u>, Vol. 58 (1968), 622-651.

[15] L. A. Brown and E. G. Moore, "Intra-urban Migration Process : A Perspective." <u>Geografiska Annaler</u>, Vol. 52B (1970), 1-13.

place utility. As a result, the household has to look for an alternate residence that meets its apsired place utility.

Before the actual search for an alternate dwelling unit begins, the household has to specify the place utility it expects of a dwelling unit. The range of place utility that are acceptable to the household forms its aspiration region.[16] Vacancies with place utility outside this aspiration region would not be considered. All other vacancies are evaluated by their respective place utility, as perceived by the household. The vacancy that the household expects best to meet its aspired place utility, provided all other things being equal, would be chosen.

The second behavioral parameter that is relevant to migration study is the action space which is "that part of the limited environment with which the individual has contact,"[17] or "those locations for which the intended

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[16] Ibid., p. 5.

[17] Wolpert (1965), op. cit. p. 163. Wolpert discussed the "Field Approach to Search Behavior". He likened the action space to Lewin's life space of an organism. This action space arises out of an individual's need of and response to the environment. Both sampling and non-sampling error occurs because the probability for an individual to interact with his immediate surroundings is greater than with those far away. Non-sampling errors result from man's ability to perceive the environment and his limited observations and exposure. Moreover, man is rather fixed to specific locations and there are spatial characteristics of the action space to which he responds. Consequently an individual's action space does not necessarily match with the "physically objective world."

migrant possesses sufficient information to assign place utilities."[18] The analogous terms for the action space are the awareness space[19] and the mental map.[20] As the awareness space contains locations that the household has knoweldge of, the search for an alternate residence would be carried out only in areas within the awareness space. Vacancies with the expected place utility of a household but located outside the awareness space would not be considered because the household cannot evaluate its place utility.

An individual's awareness space does not include the entire urban area except in very small towns. This awareness space is built up through the individual's daily activities. These activities would include the daily work trip, shopping trips, and social visits. The routes of these trips are fairly fixed over a short time thereby inducing little change in the awareness space. However, there may be a change in job location so that the work trip now traverses a larger portion of the urban area. A change in shopping trips can be brought about by the opening of new shopping center. The social visits may be changed as new friends are acquired or as old ones

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[18] Brown and Moore, <u>op. cit</u>. p. 1.

[19] <u>Ibid</u>., p. 7-8.

[20] J. S. Adams, "Directional Bias in Intra-urban Migration." <u>Economic Geography</u>, Vol. 45 (1969) 302-323.

change their residences. As a result, the awareness space enlarges its size with time.[21]

The relevance of the place utility and awareness space concepts has been established. However, very little research has been done to establish the empirical regularities of the awareness space.

Similarly, there have been very few attempts made to construct operational models in the intra-urban migration context. Brown, Horton, and Wittick[22] attempted to operationalize the concepts of place utility and awareness space by using the classic transportation model :

(I) $$\text{Min } Z = \sum_i \sum_j x_{ij} C_{ij}$$

Subject to

$$M_i \geq \sum_j x_{ij}$$

$$v_j \leq \sum_j x_{ij}$$

$$x_{ij} \geq 0$$

$$\sum_i M_i = \sum_j v_j$$

where x_{ij} = migration from origin node i to destination node j
C_{ij} = cost of migration
M_i = migrants from node i
v_j = vacancies in destination node j

The model states that migration from one area to another is

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[21] However, a spatial discounting procedure may occur. The locations previously known to the individual are no longer used and are replaced by new ones. See F. E. Horton and D. R. Reynolds, "Effects of Urban Spatial Structure on Individual Behavior." Economic Geography, Vol. 47 (1971), p. 39.

[22] L. A. Brown, F. E. Horton, and R. I. Wittick, "On Place Utility and the Normative Allocation of Intra-urban Migrants." Demography, Vol. 7 (1970), 175-183.

such that the cost of migration is minimized (equation I) and the differential place utility between the destination and the origin is maximized (equation II). The cost of migration integrates both the concepts of place utility and awareness space.

(II) $\text{Max } Z' = \sum_j v_j w_j - \sum_i M_i u_i$

Subject to

$w_j - u_i \leq C_{ij}$

$v_j w_j$ = aggregate value of migrant households located at j

$M_i u_i$ = aggregate value of migrant households located in their original places.

To operationalize the concept of place utility, it is given a distance decay function as it is assumed that the migrant's knowledge of the city decreases with the distances away from his initial residence. The function used is the Pareto-exponential function.[23] The values estimated for Y is standardized and its reciprocal is used. This reciprocal of the Y values would represent the probability of a migrant in one area having knowledge of a vacancy in another area and varies from zero to one. The probability would be zero if the vacancy is outside a migrant's awareness space while the search effort would be at its maximum value. The search effort decreases with

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[23] Ibid., the form of this function is $Y = aD^{-b}e^{-cD}$ where Y is the relative level of knowledge about a location D distance away.

decreasing distance away from the migrant's original residence.

The place utility concept can be seen as the aspiration set of the migrant. This functions in the intra-urban migration process in two ways. The first is, identifying the location within the awareness space which are most likely to provide acceptable vacancies and the second is, the selection of one vacancy from all those the migrant has evaluated. The aspiration set is operationalized by measuring the difference/distance between the subjective aspiration of a household in an area and the objective place utility of another area. This distance is estimated by the Mean First Passage Time of a Markov Chain.[24] The cost of migration is then a combination of the search effort measured by the awareness space and the difference between the subjective and objective place utility. Unfortunately, the outcome is that migrants are overallocated to adjacent areas and the distance decay function dominates the pattern.[25]

The research on intra-urban migration illustrates that the results from empirical studies are often used in constructing migration models. Empirical studies are therefore fundamental to more sophisticated research but

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[24] *Ibid.*, p. 179.

[25] *Ibid.*, p. 181.

lack predictive and operational power in themselves. In view of the lack of knowledge about the processes of intra-urban migration, carefully designed survey studies are needed. Aspects about which further research is required are the awareness space, the individual's ability to discriminate the place utility of different dwelling units and the critical level at which the lack of experienced place utility would induce a move.[26]

Ecological models have not been very successful in predicting the rates of migration. This is so because these models employ areal data which give macro-characteristics rather than micro-characteristics. As individuals respond differently to the environment, macro-data is not sufficient to study micro-behavior. Besides, it has been found that a group of variables may be associated with mobility in one area but with stability in another area.[27]

The most important criticism that can be made of the distance decay function is that assumptions are made with regard to the process of migration. The probabilities for contact are assumed to decrease with increasing distance from the migrant's initial location. Moreover, the

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[26] This is concerned with the problem of when a stress will become a strain on the individual. See J. Wolpert, "Migration as an Adjustment to Environmental Stress." Journal of Social Issues, Vol. 22 (1966), 92-102. Brown and Moore, op. cit. p. 2-3.

[27] Brown and Longbrake, op. cit.

distance decay function implies that chances for contact decrease in all directions away from a location. This is clearly not the case in an urban area. The chances for contact depend rather on the individual's trip distance preference and the relative dispersion of population densities within an urban area.[28] The latter variables can be regarded as the spatial distribution of work places, shopping facilities, and the density of residential land use.

In strongly mononuclear urban areas the work places and shopping facilities are normally concentrated in the central business area, as is the case in Burgess' concentric zone city. The intensity of residential land use would also decrease with increasing distance from the center of the city. Under such ideal situation, the probabilities for contact would conform to a distance decay function only if the individual is located at the center of the city. Given a preference for a certain trip distance, any individual located some distance away from the CBD would have the greatest chance to interact at a point somewhere between the CBD and the individual's location.[29]

Furthermore the concentric zone city model seldom fits real world situations, especially with the increasing

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[28] E. G. Moore, "Some Spatial Properties of Urban Contact Fields." Geographical Analysis, Vol. 2 (1970), 376-386.

[29] Ibid., p. 379-381.

suburbanization of commercial, industrial, and retail land use. An individual may reside in one part of a city and work in another part of the same city. If he shops and visits friends near to his home, a distance decay awareness space can then be centered on his home. However, a large proportion of his time is spent at his work place around which a distance decay awareness space may develop. This awareness space would not have as wide a scope as the one around his home as his movements would be limited by the lack of available time. Unfortunately, very little is known of the area through which he travels to and from work. In this case, an individual's awareness space cannot be described by a single distance decay function. The awareness space is comprised of two subsets, which are spatially separated and only weakly linked together. Consequently, there is a need to study the awareness space in the intra-urban context.

CHAPTER II

INTRODUCTION 2

Objectives and Background

It has been shown in Chapter I that the awareness space of an individual is relevant in intra-urban migration studies. Unfortunately, very little research has been done to establish the empirical regularities of the awareness space. In this chapter, an attempt is made to justify the use of migration origins and destinations to study the awareness space.

When a household moves from one residence to another, it shifts its location in space. The most important geographic elements of these two points in space are their distance and direction from each other. Consider the diagram below, where a household has moved a distance m to the destination which is due east of the origin. How-

ever, these points could be used to represent any other movement unless we specify that a household located originally at x has moved to y.[1]

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[1] This and the following discussion is taken from Nystuen, "Identification of Some Fundamental Spatial Concepts." Michigan Academy of Science, Arts, and Letters, Vol. 48 (1963), 373-384.

In order to understand the importance of the directional, orientation and distance attribute between the origin and destination, it is assumed that the urban area conforms to a concentric zone model. Any household that requires a better urban environement and new home would invariably move to locations further from the center of the city than its original residence. If better accessibility to the CBD is preferred, movement would be to locations closer to the city center. The length of move would depend on the direction the household is moving to and its initial location in the urban area. If the migrant is located at the downtown area, the longest distance he can move to improve his housing quality is the radius of the urban area unless he prefers living outside the urban area. On the other hand, he cannot move very far to improve his accessibility to the CBD. The further the original residence is located from the CBD, the shorter the distance the migrant would be able to locate himself further from the CBD than the original residence. The reverse is true for migrants who prefer accessibility to the center of the city. It can be seen that the location of the initial residence and the type of movement determines the location of the new residence site.

Unfortunately, urban areas seldom conform to the concentric zone model and a large urban area often contains very diversified subareas. As a result, a migrant household with a specific set of aspirations cannot move to any location in the urban area. Besides, it has been shown that the awareness space of an individual does not encompass the entire urban area. The migrant would only move to areas within his awareness space. It is therefore suggested that a study of the geographic elements between the origins and destinations can reveal the spatial properties of the awareness space.

The first attempt to employ the concept of the awareness space or the mental map to study the geographic elements of the origins and destinations is Adams' study of Minneapolis.[2] The basic assumptions of this study are the concentric zone city model and the wedge-shaped mental map centered on a line or arterial road linking the CBD and the residence of a migrant. Another restraint is that the availability of vacancies decreases with increasing distance from the city center. It is then hypothesized that the length of move increases with increasing origin distance from the CBD and decreases with increasing move angle. As well the move angle decreases with increasing origin distance from the CDB.[3] However, the observed relationships, though conforming to the hypothesized direction

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[2] Adams, <u>op. cit.</u>

[3] <u>Ibid</u>., p.315.

and being statistically significant, are not strking.[4] This is because the length of move depends not only on the location of the original residence but also on the direction of the move. Moreover, the move angle is not used to gauge the mental map of the migrants.

Brown and Holmes[5] employ the centrographic methods to measure the distance, direction and sectoral bias. In fact these biases are the geographic elements between the origin and destination as the distance bias measures the tendency to move over a certain distance; the direction bias measures the preference to move to a certain direction, and the sectoral bias measures the tendency to move along a certain line or within a certain sector. Before applying the measures to the data, all destinations are reduced to having a common origin.[6] The present study employs the methods used by Brown and Holmes. A discussion of the methodology is given in Chapter III.

Before any hypothesis is made with regard to the geographic elements between the origin and destination of a move, a summary of the spatial characteristics of the study area, Metropolitan Winnipeg, will be presented. The spatial characteristics that are relevant to the study of the

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[4] Ibid., p.315, Table V.

[5] Brown and Holmes, op. cit.

[6] See below and Ibid.

awareness space are the barriers that impede movement,[7] and the distribution of work places, shopping facilities, housing quality and density.

It is important to elaborate on the effects of barriers on the awareness space as this has not been done before. Barriers impeding movement, whether people or ideas, may be physical and/or social barriers. Physical barriers are of greater importance in the urban area, because these barriers prevent free movement and may even channel movement within well defined lines. The urban inhabitant's perception of the urban form would then be incomplete and sectioned. Social barriers often separate a spatially concentrated subgroup from the majority of the population. However, social barriers may disintegrate easily if the subgroup concerned can be readily assimilated into the urban melting pot.

Physical Barriers

The City of Winnipeg[8] originated at the confluence of the Red and the Assiniboine Rivers. Urban growth since incorporation has never been uniform around the primary core, but concentrated mostly in the northern and wastern section until 1882 when the Hudson's Bay Company "Reserve"

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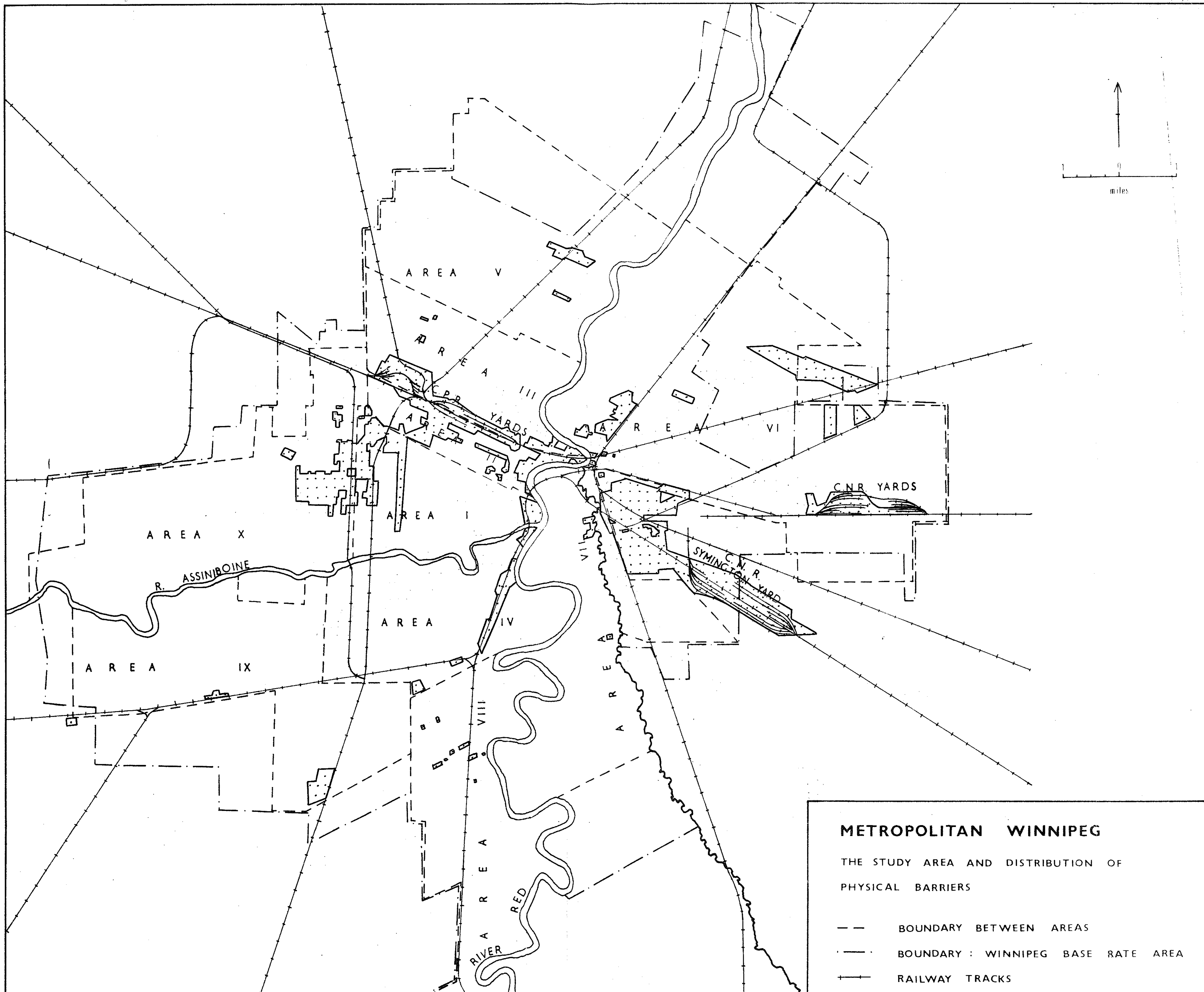
[7] For an account of the effect of physical structures on man's perception of the environment, see K. Lynch, The Image of the City. (Cambridge, M.I.T. Press, 1963).

[8] This refers to the old City of Winnipeg. Cities and municipalities making up Metropolitan Winnipeg were amalgamated into the City of Winnipeg as of January 1, 1972.


METROPOLITAN WINNIPEG
THE STUDY AREA AND DISTRIBUTION OF PHYSICAL BARRIERS
BOUNDARY BETWEEN AREAS
BOUNDARY : WINNIPEG BASE RATE AREA
RAILWAY TRACKS
AREA V
AREA III
AREA II
AREA I
AREA IV
AREA VI
AREA VII
AREA VIII
AREA IX
AREA X
C.P.R. YARDS
C.N.R. YARDS
C.N.R. SYMINGTON YARD
R. ASSINIBOINE
RED RIVER
miles

went into private hands which made expansion to the south possible.[9] St. Boniface was established as early as 1818 as a Catholic mission post, but had never experienced the phenomenal growth as has the City of Winnipeg. The reasons are that St. Boniface is separated from the latter by a river and has always served as an exclusive area for French speaking residents. However, the physical barrier exerts a greater influence. If the river is not adequately bridged, little urban growth can occur on the banks away from the dominating core. The result is an asymmetrical development around the core.[10] The most extensive subdivision has occurred, and is still actively being carried on, to the west of the CBD along the northern bank of the Assiniboine River and to the north along the western bank of the Red River. Once the Assiniboine River was bridged, development quickly occurred to area south of it. The two rivers thus divide the urban area of Metropolitan Winnipeg into three main parts.

Besides natural physical barriers, man-made barriers result from Winnipeg's function as a transportation, distribution, and collecting center for the prairies.[11]

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[9] H.A. Hossé, "The Areal Growth and Functional Development of Winnipeg from 1870 to 1913." (Unpublished M.A. Thesis, Department of Geography, University of Manitoba, Winnipeg, 1956).

[10] P. R. Gould, Spatial Diffusion. (Commission on College Geography, Resource Paper No. 4, Association of American Geographers, Washington, D. C., 1969).

[11] Hossé, op. cit.

These functions depend heavily on the availability of transportation means. The navigable Red River led to the growth of Winnipeg. The railways subsequently eclipsed navigation and dominated the scene until the advent of motor transport. As a result, the area within Metropolitan Winnipeg is well criss-crossed with railway yards and tracks. Indeed, both the CNR and CPR have their largest railway yards in western Canada at Winnipeg. The CNR yards in the City of Transcona do not form a great physical barrier as compared to the CPR yards which lie in the heart of the oldest area and one of the most densely populated areas. Furthermore, the CPR yards can only be crossed at three points : the McPhillips Street, Salter Street, and the Arlington Bridges. The CNR yards lying between the subareas Riverview and Fort Rouge also form a considerable barrier to perception as there is no bridge connecting the two areas (Figure 1).

Road arteries also radiate out from the center of the city to various parts of the province. These are also major routes leading from the urban fringes to the CBD and experience considerable utilization. As their widths are limited in extent, they are not barriers to perception but are in fact perception channels focusing on the CBD. In this context, these arteries guide the perception of the inhabitants and therefore may have a great influence on the choice of new residence sites.

Social Barriers

In addition to the subdivision of the metropolitan area by physical barriers, both natural and man-made, social factors also lead to segregation. The segregation of groups according to social factors existed before the City of Winnipeg was incorporated. At that time, the dividing factor was one of religion. The Census of Assiniboia in 1856 showed that St. Boniface, St. Norbert, and St. Francois-Xavier contained mostly French speaking Roman Catholic families while the other parishes accomodated mainly English speaking Protestant families.[12] This segregation of the French speaking people still exists today.

Ethnic origin is another factor that causes segregation in Greater Winnipeg. Various European settlers began to enter southern Manitoba after 1870. However, some stayed in the City of Winnipeg to take advantage of the growing trade. The newly arrived immigrants tended to settle in the oldest part of the city and gradually displaced the Anglo-Saxons. The concentration of non-British ethnic groups in subarea North-end persists today even though there are evidences that the diffusion of these groups to

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[12] R. D. Fromson, "Acculturation or Assimilation : A Geographic Analysis of Residential Segregation of Selected Ethnic Groups : Metropolitan Winnipeg 1951-1961." (Unpublished M.A. Thesis, Department of Geography, University of Manitoba, Winnipeg, 1965). Chapter II.

contiguous areas is occurring.[13] These ethnic groups have, of course, limited knowledge of the city as they are hindered in their movement around the urban area by linguistic barriers for at least some time after their arrival. Linguistic barriers are found to be the most stable and long-lasting barriers.[14] This accounts for the persistence of the North-end area as an entrance area for immigrants because most of them would like to live near their fellow nationals. According to Fromson, though there has been some dispersion of the major ethnic groups towards other parts of the city, the dispersion is very limited in extent and is confined mainly to that part of the metropolitan area north of the Assiniboine River.[15]

Spatial Pattern of Work Places and Retail Outlets

The location of work places in Metropolitan Winnipeg is highly concentrated. The downtown area provides about fourty percent of all employment opportunities while the old City of Winnipeg as a whole provides approximately seventy percent of the available metropolitan employment.[16] St. James, ranking as the second largest provider of employment, provides only slightly more than six percent

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13 *Ibid.*, Chapter III.

14 Gould, *op. cit.* p.16.

15 Fromson, *op. cit.*

16 *Winnipeg Area Transportation Study*. Metropolitan Corporation of Greater Winnipeg, Street and Transit Division, Street and Traffic Department, 1966. p.28.

of the total employment. This indicates that in terms of employment opportunity or work place location, the metropolitan area is still largely mononuclear and CBD oriented.

Shopping facilities can be regarded as evenly distributed. Suburban shopping centers have been established in every suburbs.[17] However, much of the shopping is still being done in the downtown area where the specialty shops are located. It is estimated that the downtown retail outlets can withstand competition from their suburban counterparts.[18] The reasons are the good accessibility provided by the transit system and parking facilities for private vehicles and a large central labor force. It is expected that the downtown retail outlets will still command 21.3% of the total retail sales by 1986.[19] As a result, the downtown area of Winnipeg still forms a point of attraction.

Spatial Pattern of Residential Land Use

The spatial pattern of residential density in Metropolitan Winnipeg conforms largely to the concentric ring model, with high density residential use in and around the central business district and low density single family

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[17] R. G. Morris, "An Evaluation of the Functions and Characteristics of a Regional Shopping Centre -- Polo Park, Winnipeg." (Unpublished M.A. Thesis, Department of Geography, University of Manitoba, Winnipeg, 1966).

[18] A Market Analysis for Metropolitan Winnipeg. By Reid, Crowther and Partners Limited, 1967. Chapters 2 and 3.

[19] Ibid., p.70.

dwelling units at the periphery of the urban area.[20] The presence of high rise apartments and rooming houses accounts for the high density of resident land use. In Winnipeg, more than 50% of all the apartment units occur within a one-and-one-quarter-mile radius from the intersection of Portage Avenue and Memorial Boulevard.[21] All other concentrations are along major arterial roads.

The spatial pattern of residential area according to socio-economic variables does not conform to the concentric zone model. The deviations result from two sources. The first one is due to historical incidence.[22] Since the incorporation of Winnipeg as a city to the present day, the most expensive residential structures have always occurred along the river banks. The second source is a consequence of the recent redevelopment of the downtown area with the construction of high rise apartments.

Hypotheses

The above account of the physical and social barriers and the spatial distribution of work places, shopping facilities and residential structures shows that the metropolitan area is subdivided into several sections but all activities are strongly oriented to the CBD. As a

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[20] Winnipeg Area Transportation Study, op. cit. p.26 and Plate 8.

[21] Analysis of Apartments in Metropolitan Winnipeg. A Study of Occupancy and Parking Factors Related to Zoning. By Reid, Crowther and Partners Limited, 1969.

[22] Hossé, op. cit.

result, it is anticipated that a study of the geographic elements between the origin and destination would reveal the role of the mental map in intra-urban migration. A number of working hypotheses are specified :

(1) Given that the awareness space of the migrants does not encompass the entire city and results from daily activities, intra-urban migration would display directional, distance, and sectoral bias.[23]

(2) Since moves are mostly to and from pre-existing dwellings, the directional bias are not necessarily towards the suburbs.

(3) A migrant's knowledge of the city is restricted in areal extent by the presence of both physical and social barriers. It follows that destinations would be contained within the area of the original residences.

(4) The city is not homogeneous in residential structures. The choice of new residences therefore reflects the distribution of the type of dwelling sought. It follows logically that moves into different dwelling types would give rise to different directional, distance, and sectoral bias.

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[23] For the definitions of these terms, see Chapter III.

The Data Source

The lack of adequate data for migration study has always been a great obstacle.[24] Intra-urban migration is a highly individualistic undertaking. The use of aggregate areal data such as census tract data to study the behavioral attributes of intra-urban migration would obliterate individual characteristics. Sources of non-grouped data were sought. Fortunately, successful contact was established with the Manitoba Telephone System (MTS) and access to the order forms was granted to the writer.

The Order Department of the MTS prepares an order form when a client requests the installation of a telephone, the disconnection of a telephone, and the transfer of a telephone from one address to another.[25] In the first two instances, a client has moved into or out of a dwelling unit respectively. Very often, the original residence and the destination are out of the metropolitan area or out of the province. As a result, these orders are excluded from the sample. When the telephone is transferred from one address to another, a change of residence must

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[24] For a review of the sources of data used by researchers in migration studies, see H. A. Freedman, "Intra-urban Mobility in Toronto : A Study of Micro-Migration Analysis." (Unpublished M.S. Thesis, Department of Geography, Pennsylvannia State University, 1967).

[25] The move of a telephone from one part of the house to another part is also included but can be easily detected.

have occurred within the Winnipeg Base Rate Area.[26] It is this subset of the order forms that was used for the present study.

It is obvious that the sample does not include all moves that have taken place. Inter-urban and rural-urban migrants are excluded, as are the newly established households which enter the housing market for the first time. Besides, a telephone is installed at the request of a client and there are still some families that share a telephone with their neighbor or do no have the service of one. In spite of the incomplete coverage, it is considered that telephone data give a better representation of the mobile sector of the population than other utility data.[27]

Pairs of addresses were taken from the order forms for the month of August, 1970. There was no special reason for choosing this particular month, but only that this was the time when successful contact with the MTS was made and access was granted to the writer to such records. Besides, these order forms are only kept for a period of three months and then discarded. No order forms

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[26] See Figure 1 for the boundary of the Winnipeg Base Rate Area. Within this base rate area, service charge is standardized. No transfer of telephone can be done between base rate areas.

[27] Not every dwelling unit uses gas. Charge for water and sewage is only levied on owners of dwellings and electricity is installed at the request of the owner of the dwelling unit.

from subsequent months were considered as the sample is rather large (altogether 1,564 pairs of addresses were used for the final analysis), and is considered to be representative of the population. When discussing time-space transformations, Harvey noted that, "the ergodic theorem states that an infinitely long record at one point has the same statistical properties as a long record taken over an infinite number of spatial ensembles at a particular point in time."[28] Certainly, the present sample can be regarded as taken over an infinite number of spatial ensembles as it records all moves showing origins and destinations. However, in terms of human time scale, the time dimension is not unity and it spreads over a period of over thirty-one days. This is unavoidable if the sample is to be sufficiently large.

The addresses obtained were located on a cartesian coordinate system superimposed on the city map. The Y-axis runs in a north-south direction and the X-axis runs in a east-west direction. They intersect each other at the junction of the Portage Avenue and Main Street, which is considered to be the heart of the CBD.[29] The size of

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[28] D. W. Harvey, "Pattern, Process, and the Scale Problem in Geographical Research." Transactions of the Institute of British Geographers, No. 45 (1968), p.77.

[29] The coordinates are located in this way in order to facilitate the rotation and translation of axes. As a result, the value of the X-axis for a point in the second and third quadrant would have a minus sign while the value of the Y-axis for a point in the third and fourth quadrant would also have a minus sign.

the grids used is one sixteenth of a square mile. Such a size of grids would eliminate the influence of those moves that are extremely short and which do not involve the awareness space, since the origin and destination in such cases would be located on the same grid point.

CHAPTER III

METHODOLOGY

The origins and destinations of intra-urban migration can be regarded as separate point sets within the urban area. To measure the distribution of these points, various methods have been used. The most common ones are the centrographic measures, for example, the mean center, the median center, the standard radius, and the standard ellipse.[1] These measures are adopted from univariate statistics.[2] The formulas used in computing these measures will be briefly discussed. As the data used are not grouped according to areal units (for example, census tracts),

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[1] D. W. Lefever, "Measuring Geographic Concentration by Means of the Standard Deviational Ellipse." _American Journal of Sociology_, Vol. 32 (1926), 88-94.

P. H. Furfey, "A Note on Lefever's "Standard Deviational Ellipse"." _American Journal of Sociology_, Vol. 33 (1927), 94-98.

F. J. Linders, "Uber die Berechnung des Schwerpunkts und der Tragheitsellipse einer Bevolkerung." _Atti del Congresso Internazionale per gli Studi Sulla Popolazione_, Vol. 10 (1934), 159-166.

R. Bachi, "Standard Distance Measures and Related Methods for Spatial Analysis." _Regional Science Association, Papers_, Vol. 10 (1962), 82-132.

D. B. Lee, "Analysis and Description of Residential Segregation : An Application of Centrographic Techniques to the Study of the Spatial Distribution of Ethnic Groups in Cities." (Master's thesis, Division of Urban Studies, Cornell University, Ithaca, New York, 1966).

L. A. Brown and J. Holmes, "Intra-urban Migrant Lifelines : A Spatial View." _Demography_, Vol. 8 (1971), 103-132.

R. S. Yuill, "The Standard Deviational Ellipse : An Updated Tool for Spatial Decription." _Geografiska Annaler_, Vol. 53B (1971), 28-39.

[2] Lee, _op. cit_. Chapter II and III.

only formulas for non-grouped data are given.

Before the computation of the centrographic measures is carried out, the distribution to be studied has to be located according to their positions on the coordinates of a pair of orthogonal axes. This pair of axes can be drawn anywhere on the map, either at the edges or in the center of the map. A general practice is to draw the two axes through a point around which most of the distribution appears to cluster. The intersection of these axes then forms the arbitrary origin of the distribution. Once this pair of axes is located, the positions of all the points in a distribution can be determined.

The mean center or the center of gravity is the position around which most of the distribution occurs. It is analogous to the univariate mean. The first step in computing the mean center is to determine the deviations of each point from the axes and then sum the deviations separately for the X- and Y-axis.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i - \mu}{n}$$

$$\bar{y} = \frac{\sum_{i=1}^{n} y_i - \mu}{n}$$

where μ = the arbitrary origin

n = the total number of observation

Since μ is the origin and equals zero, the formulas would be reduced to

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$$

The intersection of these values determines the location of the mean center. Unfortunately, this location would only be accurately determined if the points are evenly distributed. Its position would shift towards the deviant points if the distribution is skewed as the deviant points have a heavier weight on the mean value.[3]

After the location of the mean center is determined, a new pair of orthogonal axes is drawn through this mean center and all the points in the distribution are relocated with the mean center as the origin.

A measure of dispersion is important in decribing the pattern of a distribution. The standard deviation in univariate statistics accurately portrays the dispersion of a distribution around the mean and is adopted here to measure the scattering of areal data. As the areal data are distributed over a two-dimensional surface, a standard deviation is calculated for each of the axes.

$$SD_x = \left[\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n} \right]^{1/2}$$

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[3] For a discussion of the properties of the mean center, see Lee, <u>op. cit</u>. p.25.

$$SD_y = \left[\frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n} \right]^{1/2}$$

Since $\bar{x}$, $\bar{y}$ form the new origin and equal zero, the formulas are reduced to

$$SD_x = \left[\frac{\sum_{i=1}^{n} (x_i)^2}{n} \right]^{1/2}$$

$$SD_y = \left[\frac{\sum_{i=1}^{n} (y_i)^2}{n} \right]^{1/2}$$

SD_x would indicate the dispersion about the Y-axis and SD_y shows the dispersion about the X-axis.[4]

The standard deviations about the Y- and X-axis only indicate the dispersion about their respective axis. A generalization of the dispersion around the mean center is needed. This is given by the standard radius.[5] It is the quadratic average of distances from the mean center :

$$STR = \left[\frac{\sum_{i=1}^{n} \left\{ (x_i - \bar{x})^2 + (y_i - \bar{y})^2 \right\}}{n} \right]^{1/2}$$

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4 Unlike the procedures employed by most authors, the distribution in the present study is not re-located with the mean center as the origin. Consequently, the values of $\bar{x}$ and $\bar{y}$ do not equal zero.

5 see Lee, _op. cit_. p.27. This is named standard distance by Bachi, _op. cit_.

$$= \left[\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n} + \frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n} \right]^{\frac{1}{2}}$$

$$= \left[SD_x 2 + SD_y 2 \right]^{\frac{1}{2}}$$

As shown above the quadratic average distance from the mean center can be reduced to the square root of the sum of the variances of the X- and Y-axis. The standard radius can also be calculated as the mean quadratic distance with the repetition between any pair of cases, divided by $\sqrt{2}$.[6]

By rotating the axes counter-clockwise around the mean center, each point would assume a new location with regard to the new pair of axes. The new location of the points can be calculated by

$$x' = x \cos\alpha + y \sin\alpha$$

$$y' = y \cos\alpha - x \sin\alpha$$

x', y' = new coordinates for the point x, y

α = the angle between each of the previous axes of the coordinates and the corresponding new axes

As the axes rotate, the value of the standard deviations about the two axes changes. However, it has been proved by Bachi[7] that :

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[6] Bachi, op. cit.

[7] Ibid.

$$d^2 = SD_x2 + SD_y2 = SD_{x'}2 + SD_{y'}2$$

It is then possible to calculate the angle α through which the axes must rotate so that the standard deviation about one of the axes is a minimum and that about the other is a maximum[8] :

$$\tan 2\alpha = \frac{2\, r\, SD_x\, SD_y}{SD_x2 - SD_y2} \qquad \text{where } r = \frac{\sum x\, y}{N\, SD_x\, SD_y}$$

The axis about which the standard deviation is a minimum shows the main direction of the distribution and is the major axis. The axis about which the standard deviation is a maximum is the minor axis. The values of the standard deviation about the major and minor axis are used for describing the standard ellipse.

The shape of the ellipse depends on the ratio of the minor axis to the major axis. This ratio is the coefficient of circularity. If the major axis equals the minor axis, that is, with a coefficient of circularity of one, the ellipse would become a circle. This would occur if the points are evenly distributed around the mean center.

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[8] Bachi, op. cit., Linders, op. cit. This formula would give the same result as that arrived at by Lefever (op. cit.) and Yuill (op. cit.), that is :

$$\tan \theta = \frac{-\Sigma x^2 - \Sigma y^2 \pm \left[(\Sigma x^2 - \Sigma y^2)^2 + 4(\Sigma xy)^2 \right]^{1/2}}{2\,\Sigma xy}$$

Another extreme condition is when the distribution is linear in form so that the dispersion about the major axis is xero. Then the ellipse would collapse to a line. Distribution patterns between these two extremes would yield a coefficient of circularity between zero and one.

There are two additional measures associated with the mean center used in the present study. They are the distance and angle of displacement. The distance of displacement is the distance by which the mean center is separated from the arbitrary origin, in this case the CBD.[9] When this distance is calculated for the rotated and translated data set, it is the average distance over which the households have moved as the arbitrary origin is the common origin.[10] The angle of displacement is "the direction by which the mean center is offset from the reference node."[11]

Another measure is used to calibrate the relative spread of the origins and the destinations. It is the relative standard radius.[12] This is obtained by dividing

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[9] Brown and Holmes, op. cit. p.110. In this study, the CBD is the arbitrary origin, the distance of displacement is just the absolute value of the location of $\bar{x}$ and $\bar{y}$ according to the coordinate system.

[10] For the rotation and translation of the axes, see below.

[11] See Brown and Holmes, op. cit. p.110. The amplitude or argument of the location of the mean center (or the angle which a line joining the mean center and the arbitrary origin makes with the positive X-axis) is determined first. Then the angle can be calculated easily by subtracting or adding the angle of rotation from or to the compliment-ary angle of the amplitude of the mean center.

[12] Lee, op. cit. p.66.

the standard radius of the destinations by that of the origins. If it is greater than unity, it indicates that spreading occurs concurrently with residential migration. If there is a greater concentration, the ratio would be between unity and zero.

The measures described above are calculated for the origins and then for the destinations. This has been done so that the location of the mean center and the form of distribution of the origins can be compared with those of the destinations. However, the purpose of the present study is an attempt to understand the role of the mental map in determining the location of the new residence. This cannot be accomplished by applying the measures to the origin and destination sets separately, because the connection between the origin and the destination is not incorporated. As a result, transformation of the data is required. The transformation has to be done in such a way that the directional and distance attributes between the origin and the destination with respect to the CBD are not altered. This is attained by the rotation and translation of the axes.[13]

As outlined in Figure 2, pairs of origin and destination are joined to the CBD. The lines linking the origin with the CBD are rotated so that they coincide with one of the axes emanating from the CBD. By this, the destinat-

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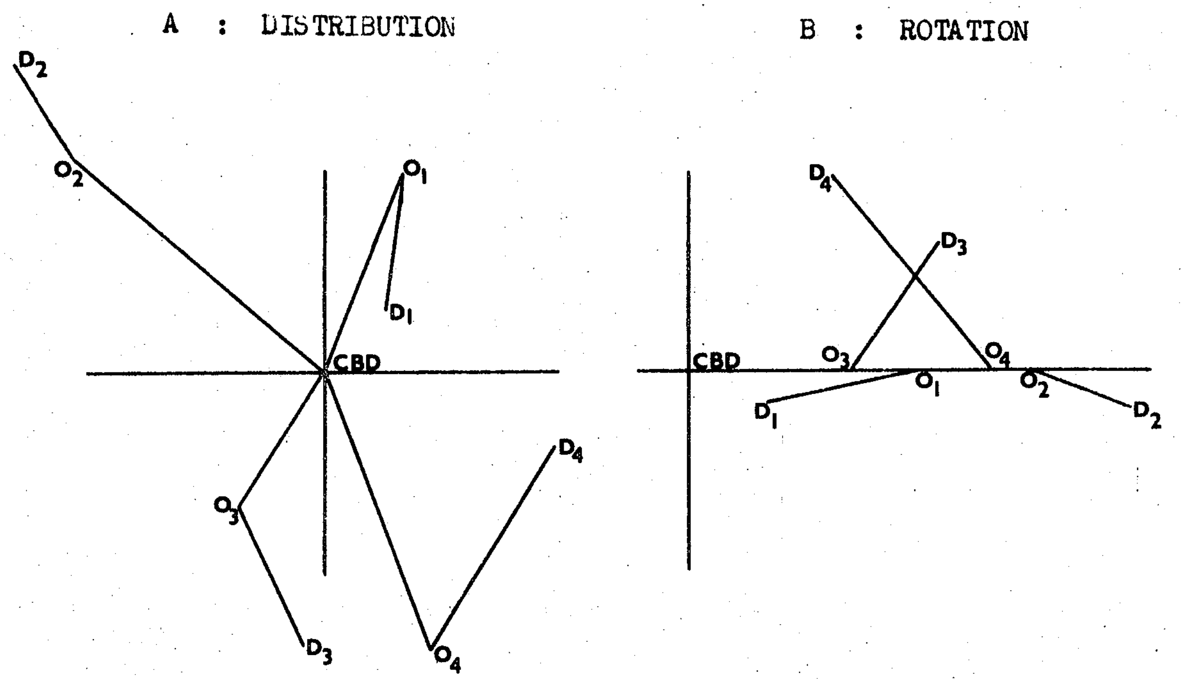
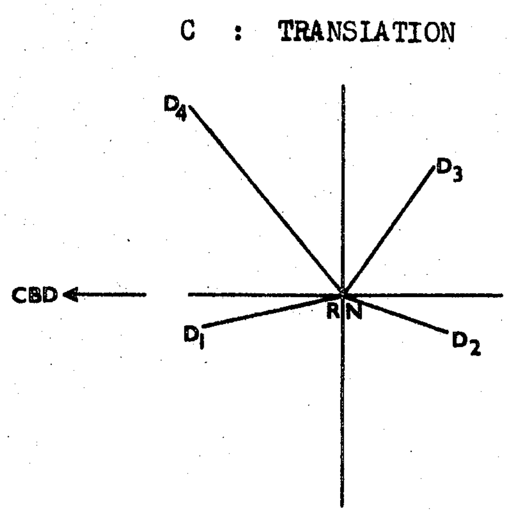
[13] Brown and holmes, op. cit. p.107-108.





RN	Reference Node
O_i	Origin
D_i	Destination
D_1, D_2	Located near a line joining the CBD and the origin
D_3, D_4	Located away from a line joining the CBD and the origin
D_1, D_4	Located nearer to the CBD than the origin
D_2, D_3	Located further away from the CBD than the origin

Figure 2 : ROTATION AND TRANSLATION OF AXES

ions are rotated through the same angle as the origins. Then all the origins are shifted to a common origin or the reference node. (In the present study, the CBD was used as the arbitrary origin and occupied the (0,0) location on the coordinates. As a result, the origins are translated to the position of the CBD.) In the process of translation, the destinations are also moved the same distance as the origins towards the reference node. By rotating and translating the axes, the distance and directional attributes between the origin and the destination with respect to the CBD are maintained.

Implications of the Measures

In spite of the fact that the effectiveness of every measure employed in gauging the spatial attributes of the moves has been expounded upon, there is a need to clarify the implications of the different measures in the study.

In every residential move, there is a distance attribute even though the new residence site may be the neighboring house. "Distance bias describes the degree to which a single migration is more likely to end in a nearby place than one more distant."[14] Following inter-county migration studies, the probability of finding a migrant in a certain place varies inversely with the distance from his original residence. Adams has argued that residents seldom have knowledge of the part of the city on the other side of

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[14] Brown and Holmes, op. cit. p.104.

the CBD which is outside the routes taken in performing daily activities.[15] The less the intended migrant knows of the area, the less he would be able to evaluate the place utility of a vacancy. As a result, more effort is required to locate a dwelling unit that will satisfy the aspired place utility. In the present study, a long average distance of move would mean that the migrants can locate anywhere in the city instead of being limited in his choice to the area where his former residence was. Short migration distance, therefore, would suggest that the migrants have a limited knowledge of the entire urban area and have definite preference in the choice of the new residence. The distance bias is measured by the standard radius.

There is a directional element between the origins and the destinations and any other point of significance in the city in every single move. The degree to which a move is more likely to end in a place that is in a particular direction from the origin or from the CBD is termed the directional bias.[16] The reason for taking the CBD as a reference point in this context is that it is important to verify the concept of 'flight to the suburbs' in intra-urban migration. If the directional bias is towards the CBD, it implies that migrants are governed by their know-

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[15] Adams, op. cit.

[16] Brown and Holmes, op. cit. p.104.

ledge of the city in the choice of new residence site and prefer to live in areas they have knowledge of. Any bias towards the suburbs would suggest that the migrants are dissatisfied with both the residence and the neighborhood. They then prefer to live in an area that they believe to be better for them. The directional bias is measured by the angle of rotation, angle and distance of displacement of the mean center from the reference node, or the CBD.[17]

The migration data can also be tested for any presence of sectoral bias which is the degree of likelihood for any move to end in a place along a line through or near the origin.[18] When the intended migrants are looking for new residence, there are as many chances for then to take up new dwellings randomly around the former residence as there are for them to be non-randomly relocated. It is hypothesized that their choices would be non-random as the urban area is not homogeneous. The urban area may be carved by physical as well as social barriers. Moreover, the types of housing also vary from subarea to subarea. The limited scope of the awareness space and the type of housing desired would therefore govern the location of

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[17] A small angle of rotation and displacement and a negatively displaced mean center would mean bias towards the CBD. An angle of rotation close to 180°, a small angle of displacement, and a positively displaced mean center would indicate strong attraction of the suburbs; see Brown and Holmes, <u>op. cit</u>., p.109-110.

[18] <u>Ibid</u>., p.104.

the new residence. If this is the case, the migration data would exhibit sectoral bias. Otherwise, the migrants would display general knowledge of the whole city, and are not restricted spatially in the process of relocation. The sectoral bias is measured by the coefficient of circularity which is a measure of evenness of distribution around the mean center.[19]

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[19] The coefficient of circularity varies from one, a circle, to zero, a line. Extreme linear bias is denoted by zero coefficient.

CHAPTER IV

APPLICATION OF THE METHODS TO AREALLY CLASSIFIED DATA

It has been shown that Metropolitan Winnipeg is divided up into sections by barriers which affect the awareness space of the inhabitants. In this chapter, the data are classified according to the areas to which the original residence belonged. In doing so, it is hoped to determine the effectiveness of the barriers in delimiting the awareness space as exhibited by the geographic elements between the origin and the destination. Besides, the attraction of the CBD and the Suburbs to the migrants from different subareas can also be ascertained.

Definition of Areas

The study area includes that part of Metropolitan Winnipeg which is tracted as of 1961 with the exception of Fort Richmond, St. Norbert, Windsor Park, and Census Tract number ninety-seven (1966). This is because non-tracted areas are largely rural in characteristics and movement from or to these areas do not involve the perception of the city. The exceptional areas are all rapidly growing suburbs and form continuous urban development with their adjacent areas. The division of the study area into ten subareas is based on the presence of physical barriers and political boundaries. It has been found that the suburbanization index exhibits a spatial form concentric in nature while the soical rank and segregation indices are spatially chaotic.[1] It is therefore difficult to subdivide the metropolitan area into continuous sub-areas with differing socio-economic status. Therefore, this earlier research using the factor analysis technique for the study area, is not taken into consideration. A description of the boundaries of each sub-area would show that each is an entity in itself, separated from its neighbors by distinct barriers.

The metropolitan area is divided into the central city and the suburbs. The central city consists of all the tracted parts of the City of Winnipeg east of the Red River. The suburbs include all the tracted areas in the cities, towns, and municipalities making up Metropolitan Winnipeg. The reason for dividing the data in this way is to test the validity of the well-known concept of the 'flight to the suburbs' from the central city. Since the area encompassed by the central city and the suburbs is very large and dissected into sections by barriers, further subdivision is necessary.

Four sub-areas make up the central city. Area I in-

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[1] R. S. Baxter, "The Use of Diagnostic Variables in Urban Analysis with Particular Reference to Winnipeg." (Unpublished M.A. Thesis, Department of Geography, University of Manitoba, Winnipeg, 1968).

cludes the 1961 census tracts number 20, 21, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, and 37.[2] These tracts include part of the CBD area and lie to the west of the Red River, north of the Assiniboine River, and south of the Notre Dame Avenue. The area is traversed by the Portage, Ellice, and Sargent Avenue. The area north of the Notre Dame Avenue and south of the Canadian Pacific Railway Yards, consisting of census tracts number 18, 19, 22, 23, 24, and 27 is Area II. The subdivision of these two areas seems superfluous at first glance. A close look at the street patterns would show that the Notre Dame Avenue separates two different street patterns. The roads north of the Notre Dame Avenue run along former lot boundaries in a north-west to south-east direction at right angles to the Red River, while those to the south also follow lot boundaries but in a north-south direction at right angles to the Assiniboine River.[3] Consequently, these two street patterns meet at sharp angles along the Notre Dame Avenue. Lynch, in his study of three American cities, has found that a break in the continuity of street patterns disrupts the perception of the city form by the residents.[4] As a result, the subdivision is justified in

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[2] The boundary between Area I and II, Area II and III, coincide with census tract boundaries which always run through uninhabited areas to avoid confusion.

[3] Hossé, op. cit.

[4] Lynch, op. cit. p.20.

view of Lynch's findings. Area III is the remaining portion of the central city north of the Assiniboine River separated from Area II by the CPR yards. The census tracts enclosed are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13. Besides being separated by the physical barrier, it is also the oldest part of the city where the proportion of recently arrived immigrant is greatest.[5] Social factors and linguistic barrier can constitute hindrances for people from this area to move into other parts of the metropolian area.[6] Area IV is that part of the central city lying to the south of the Assiniboine River. It is separated from the cities of St. Boniface and St. Vital by the Red River.

The subdivision of the suburbs is based mainly on the political boundaries between the municipalities, towns, and cities.[7] Area V, consisting of Old and West Kildonan, is only separated from Area III by the political boundary to the south, and from Area VI by the Red River. Area VI encloses Elmwood, North and East Kildonan, and Transcona. Elmwood is included as it is on the same side of the Red River as the other component parts. Area VII comprises of St. Boniface and St. Vital as these two cities form a

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[5] Fromson, <u>op. cit</u>.

[6] Linguistic barrier is the most persistent of all barriers to diffusion. See Gould, <u>op. cit</u>.

[7] These had become defunct since January 1, 1972. See Footnote number 8, Chapter II.

continuous stretch of residential development. Even though political boundaries are used to divide Area VII from Area VI, there is a break in residential development along the boundary zone, which is occupied by railway tracks and industrial land.[8] Area VIII consists of the tracted parts of the municipality of Fort Garry plus two agglomerations of newly subdivided and built-up lots, Fort Richmond and St. Norbert. The municipaltiy of Charleswood and the Town of Tuxedo make up Area IX. It is a peculiar sub-area by itself as it is still largely rural in characteristic and the socio-economic status of the residents on the whole are higher than the adjacent parts. Area X embodies only the City of St. James-Assiniboia and is separated from Area IX by the river. Similar to Area VI and Area VII, the division of Area I and Area X is one of political yet the boundary zone is occupied by a belt of commercial, industrial, and recreation land. The data of Area IX are not subjected to the analysis as the sample is too small, (there are only thirteen moves originated from Area IX).

A glance at Figure 1 would show that all the areas so subdivided are given as square a shape as possible to

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[8] See Figure 1.

minimize the effect of the shape on the data.[9] Only Areas II, VII, and VIII are markedly elongated in shape. This is unavoidable as they form distinct areas by themselves. Their shape is expected to influence the final results.

The mean centers, standard deviations, the coefficient of circularity, the standard radius, angle of rotation, distance and angle of displacement are computed for the origins, destinations, and then for the rotated and translated data for each area. The statistics for the origin set will be regarded as the norm since they are results of the distribution of points within the area concerned. They should reflect the shape and size of the area. To these, the statistics for the destination set are compared to see if there is any difference between the pattern of distribution of the origin set and that of the destination set. The measures calculated for the transformed data set would be used to determine the distance, directional, and sectoral bias so that inferences about the awareness space can be made.

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[9] Lee, _op. cit._ p.40; Bachi, _op. cit._; Yuill, _op. cit._ p.35.

All these three researchers have proved that an evenly distributed population in a rectangular area would yield an ellipse of density similar to that of a linearly distributed population inside a square area. In addition, a linear distribution perpendicular to the long axis of an area may yield a circular ellipse of density comparable to that of an even distribution in a square area. As a result, areas from which data are obtained should not be elongated in order to minimize the effect of the shape on the form of the ellipse of concentration.

Aggregative Migration Attributes in the Central City

Area I is separated from its neighbors by physical barriers. The area is elongated and tapers towards the CBD. The mean center of the origin data is located in the eastern half of the area (see Table 1 and Figure 3). This together with the small standard radius, 0.69 miles, suggest that the distribution is quite accurately portrayed by the mean center and the ellipse of concentration, and therefore is localized in the eastern section. The main direction of distribution of the origins is in a east-west direction which corresponds with the long axis of the area. The dispersion of the destinations coincides largely with that of the origins. The mean centers are close to each other and the main direction of distribution is also similar. However, the destinations are distributed over a much wider area as the standard radius is very large, about 3.35 times larger than that for the origin set. As the direction of distribution conforms with the areal long axis, it can be concluded that the physical barrier bounding the area is effective in limiting cross-movements. Unfortunately, the degree of effectiveness of the physical barriers cannot be determined.

The statistics for the rotated and translated data set are not very revealing in matters of distance, directional and sectoral bias. The directional bias cannot be established in spite of the small angles of rotation and displacement as the distance of displacement is insigni-

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-4.26	-1.77	2.17	1.7	0.78	0.69	3.35	1.49	1.15[@]	21.0
Destination	-4.31	-1.98	7.4	5.5	0.74	2.31		-12.02	1.19[@]	36.69
Rotated & Translated	-0.32	-0.01	7.1	5.94	0.84	2.31	-	-0.89	0.09[+]	2.54

TABLE : 1 STATISTICS OF INTRA-URBAN MIGRATION, AREA I

(Sample Size : 408)

[*] The origin of the coordinates is at the center of the CBD.
[@] This is the distance of the mean center from the center of the CBD.
[+] This is the distance of the mean center from the reference node.

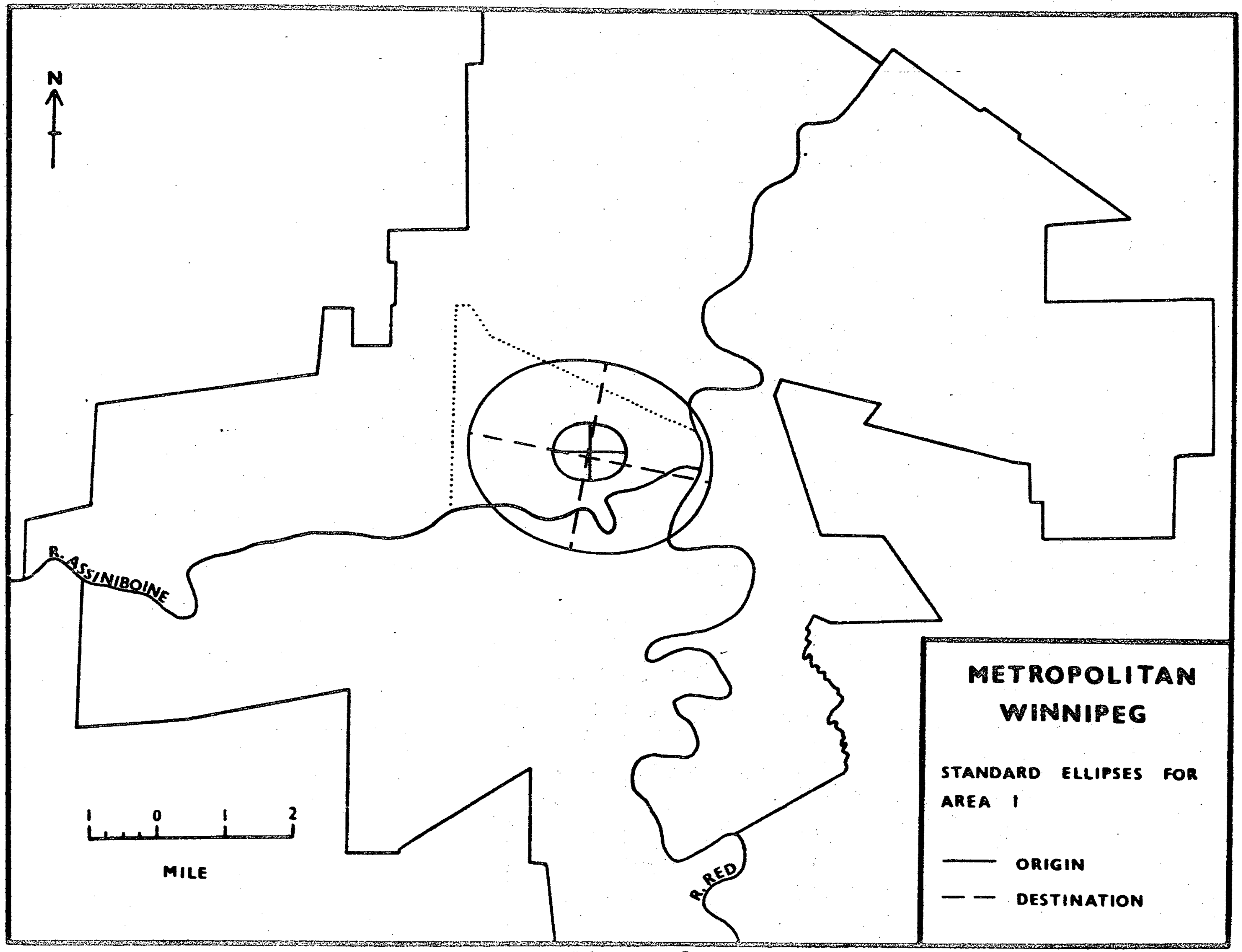
N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR AREA 1
ORIGIN
DESTINATION

Figure 3

ficant.[10] The fact that the coefficient of circularity is 0.84 shows that the postulate that an intended migrant is confined within his narrow image of the urban area when choosing new residence cannot be verified. The distance bias is difficult to determine because the standard radius describes the dispersion of the destinations in all directions from a point, (it is also the average migration distance as all destinations are reduced to having one common origin). Any conclusion with respect to the presence or absence of distance bias can only be arrived at by comparison with the standard radii for other area. In doing so, migrants from Area I can be said to have preferred to move over a shorter distance since the standard radius is the smallest amongst the others. However, the actual value of the standard radius, 2.31 miles, is large.

Area II is a very elongated area which would have influence on the statistics for the origin set. The mean center of the origin set is centrally located within the area (see Table 2 and Figure 4). However, the direction of the distribution does not reflect the influence of its shape as it is at right angles to the long axis of the area. This may be due to the fact that there are only a few moves from the western and eastern parts; the former

---

[10] Brown and Holmes, op. cit. Directional bias cannot be established if the displacement of the mean center is insignificant or in the wrong direction. See Table 1 and Figure 7.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-4.35	3.33	2.94	2.32	0.78	0.94	2.56	34.49	1.37@	71.95
Destination	-3.23	2.1	8.44	4.68	0.55	2.41		-11.69	0.96@	21.32
Rotated & Translated	-1.72	0.48	6.66	7.06	0.94	2.43	-	41.75	0.45+	32.59

TABLE : 2 STATISTICS OF INTRA-URBAN MIGRATION, AREA II

(Sample Size : 60)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

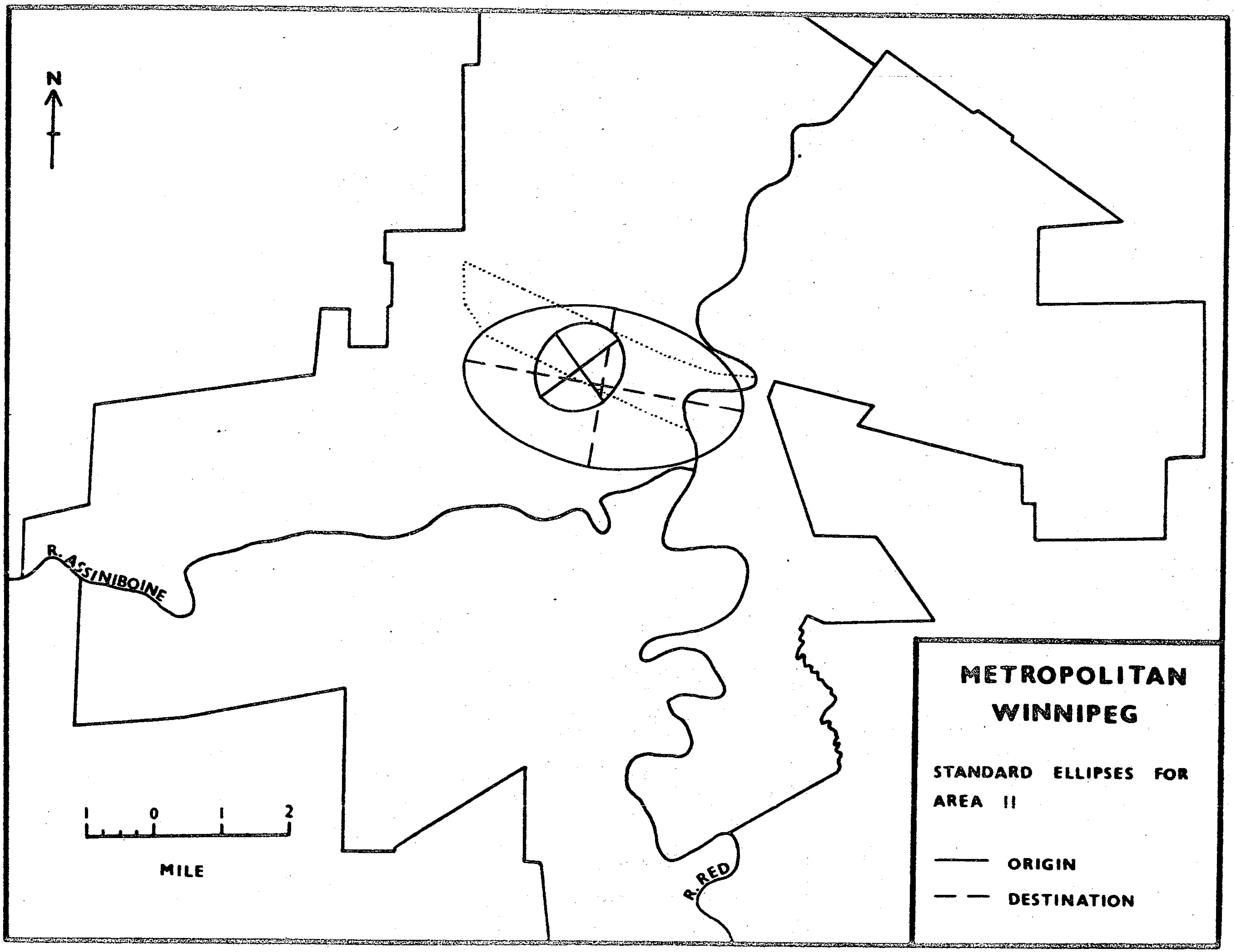
N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA II
ORIGIN
DESTINATION

Figure 4

of which is relatively undeveloped while the latter is occupied by industrial and commercial land. The scatter around the mean center is not great. On the contrary, the destinations are distributed along a east-west axis in alignment with the long axis of the area. Moreover, the spread around the mean center is very great as evidenced by the standard radius. In other words, the mean center is not a good statistic to describe the pattern of distribution. Movements across the physical barriers are occurring. This is especially so in the south where the physical barrier is easier to surmount.

As in Area I, the direction, distance, and sectoral biases are not striking. The angles of rotation and displacement are quite large, 41.8° and 63.9° respectively, showing directional bias away from the CBD. Yet the mean center is negatively displaced. As a consequence, directional bias cannot be sustained. A coefficient of circularity of 0.92 means that the migrants show no preference to relocate at a place near or on a line through the origin. In areas with limited territorial extent, if movements are within the area of the origin, there should be distance bias since the standard radius is governed by the size of the area. However, this is not the case because the standard radius is 2.43 miles.

The distribution of the origins in Area III is very similar to the preceeding areas. The scatter around the mean center is small and along a line in a east-north-east to west-south-west direction, (see Table 3 and Figure 5). The mean center is located in the south east corner as the western part is not entirely built-up and therefore generates a small number of moves. The destinations, on the contrary, are distributed in the same direction as the long axis of the area. The standard radius is very large (2.48 miles) suggesting that there are some moves ending at a great distance from the mean center. The fact that the mean center of the destinations is displaced southwards from that of the origins, is evidence for the deviant destinations to occur to the south of the area where similar type of housing can be found. Movement to the north may be hindered by the comparative lack of suitable vacancies. Such a comparison of the distribution of the destinations with that of the origins does not give evidence to substantiate the effectiveness of the physical as well as the social barriers in limiting cross-movements. The breaking down of the social barrier can be envisaged because once the immigrants have overcome the language barrier, they would have a better knowledge of other parts of the city and, they also tend to move out as their economic condition improves. Fromson has also found, empirically, that there has been evidence of some ethnic groups moving from the North-end area, that is Area III, into the adjacent areas.[11]

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[11] Fromson, op. cit.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-1.08	6.87	3.12	2.54	0.79	0.99	2.5	21.66	1.74[@]	102.74
Destination	-1.39	5.04	7.65	6.34	0.83	2.48		-24.07	1.31[@]	50.51
Rotated & Translated	-2.32	0.66	6.82	7.18	0.95	2.48	-	-33.55	0.6[+]	72.28

TABLE : 3 STATISTICS OF INTRA-URBAN MIGRATION, AREA III

(Sample Size : 230)

[*] The origin of the coordinates is at the center of the CBD.

[@] This is the distance of the mean center from the center of the CBD.

[+] This is the distance of the mean center from the reference node.

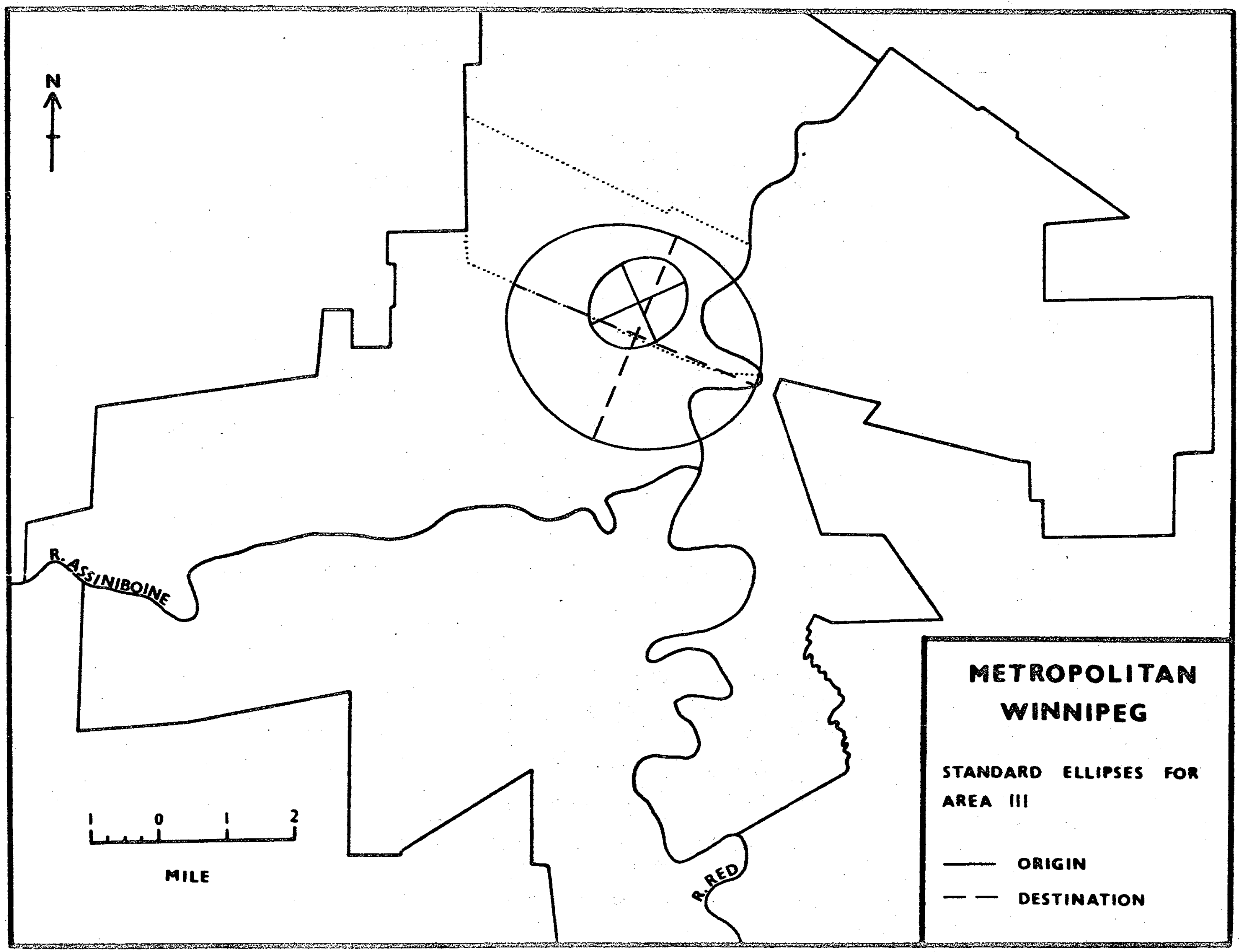

N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA III
ORIGIN
DESTINATION

Figure 5

The results of the analysis of the rotated and translated data reinforce the conclusions derived from the analysis of mobility in Areas I and II. The near unity of the coefficient of circularity demonstrates that the supposedly narrow image of the city acquired through daily activities has no effect on the selection of new residences. Even the large angles of rotation and displacement, 33.6° and 72.3° respectively, may suggest that migration from the area is oriented away from the city center. The mean center is negatively displaced, thus no directional bias can be maintained. Scatter around the mean center is quite substantial (the standard radius is 2.48 miles) so that migration from this area is not biased in terms of distance.

In Area IV most of the moves have originated from the vicinity at the junction of River-Corydon Avenue and Osborne Street, where there is a high concentration of apartment buildings. Therefore the mean center for the origin set is not located centrally in the area (see Table 4 and Figure 6). The fact that the extremity of the area in the west is occupied by a park and that the western section consists of residential areas with higher socio-economic status and therefore with greater percentage of privately owned homes must have pushed the mean center to the eastern portion. The distribution of the origins is in a east-north-east to west-south-west trend. The major axis of the destination set is oriented in more

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-3.13	-7.3	3.64	2.55	0.70	1.11	2.55	-22.63	1.99[@]	89.45
Destination	-3.99	-5.59	9.43	6.33	0.67	2.84		-9.62	1.79[@]	65.67
Rotated & Translated	-1.16	-1.27	7.09	8.37	0.85	2.74	-	-28.64	0.43[+]	13.67

TABLE : 4 STATISTICS OF INTRA-URBAN MIGRATION, AREA IV

(Sample Size : 262)

[*]The origin of the coordinates is at the center of the CBD.

[@]This is the distance of the mean center from the center of the CBD.

[+]This is the distance of the mean center from the reference node.

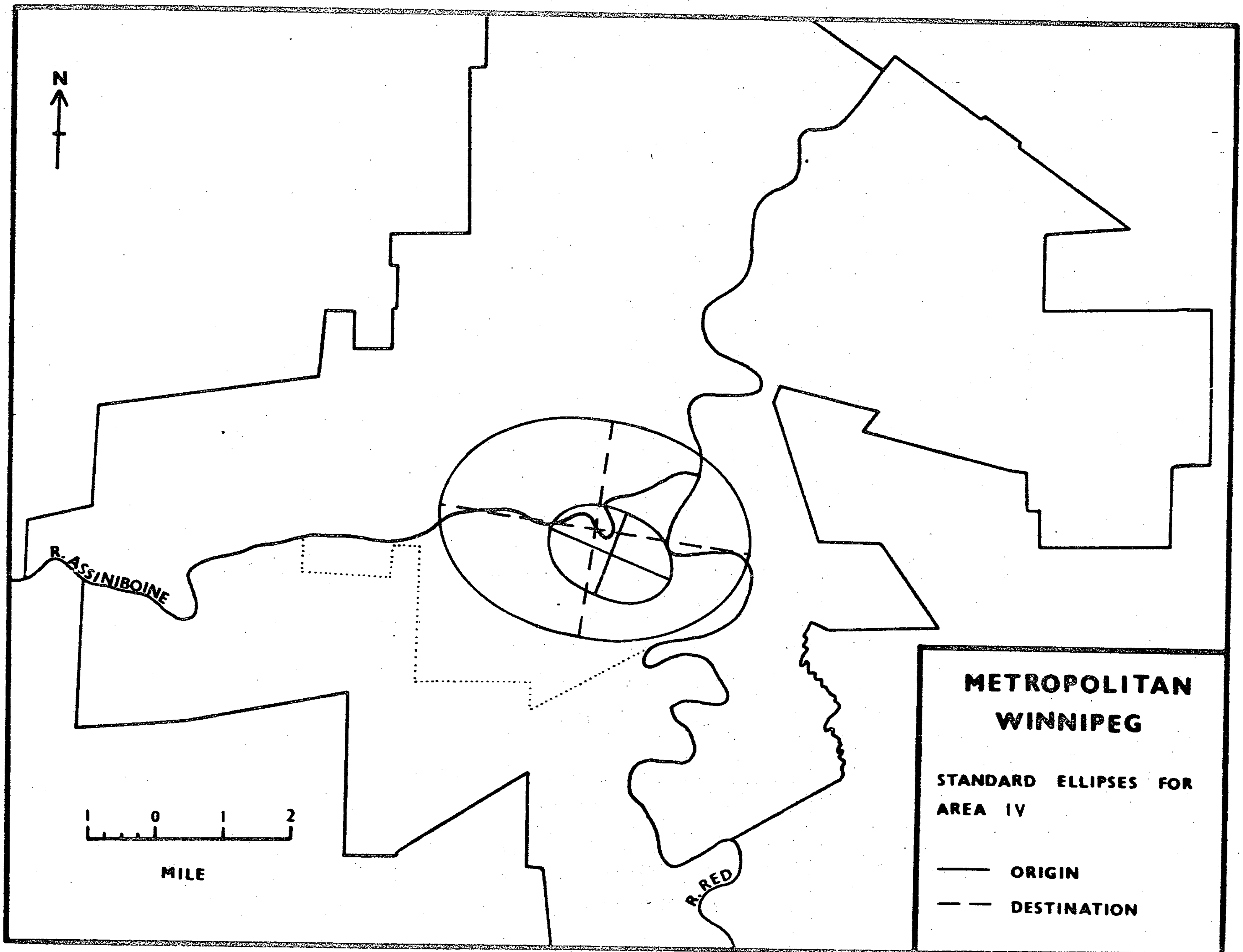

METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR AREA IV
ORIGIN
DESTINATION
R. ASSINIBOINE
R. RED
N
1 0 1 2
MILE

Figure 6

or less the same direction as that of the origins. The mean center of the destinations is located in a more northerly position than that of the origins. If the majority of the moves originated from and ended in apartment buildings, the displacement of the mean center can be explained by the gravitational pull of the similarly dense conglomeration of apartment buildings across the Assiniboine River (see Figure 14).

The conclusions that can be drawn from the statistics for the rotated and translated data set for Area III can be equally well applied to Area IV. In other words, migrants from this area do not behave according to the popular beliefs pertaining to intra-urban migration.

From the preceeding account, it is clear that there is no bias directionally, sectorally, or in terms of distance within the central city (compare the last row in Table 1 to 4, and see Figure 7). The existence of physical and social barriers do not prevent movement across them even though the majority of the destinations are still contained within the area of the origin. In the language of diffusion studies, these barriers are permeable. Unfortunately, the degree of permeability cannot be determined by the methods employed. Even though the mean centers of the destinations in many cases are displaced towards the center of the city, the CBD has neither a centripetal nor a centrifugal effect on the migrants as revealed by the rotated and translated data

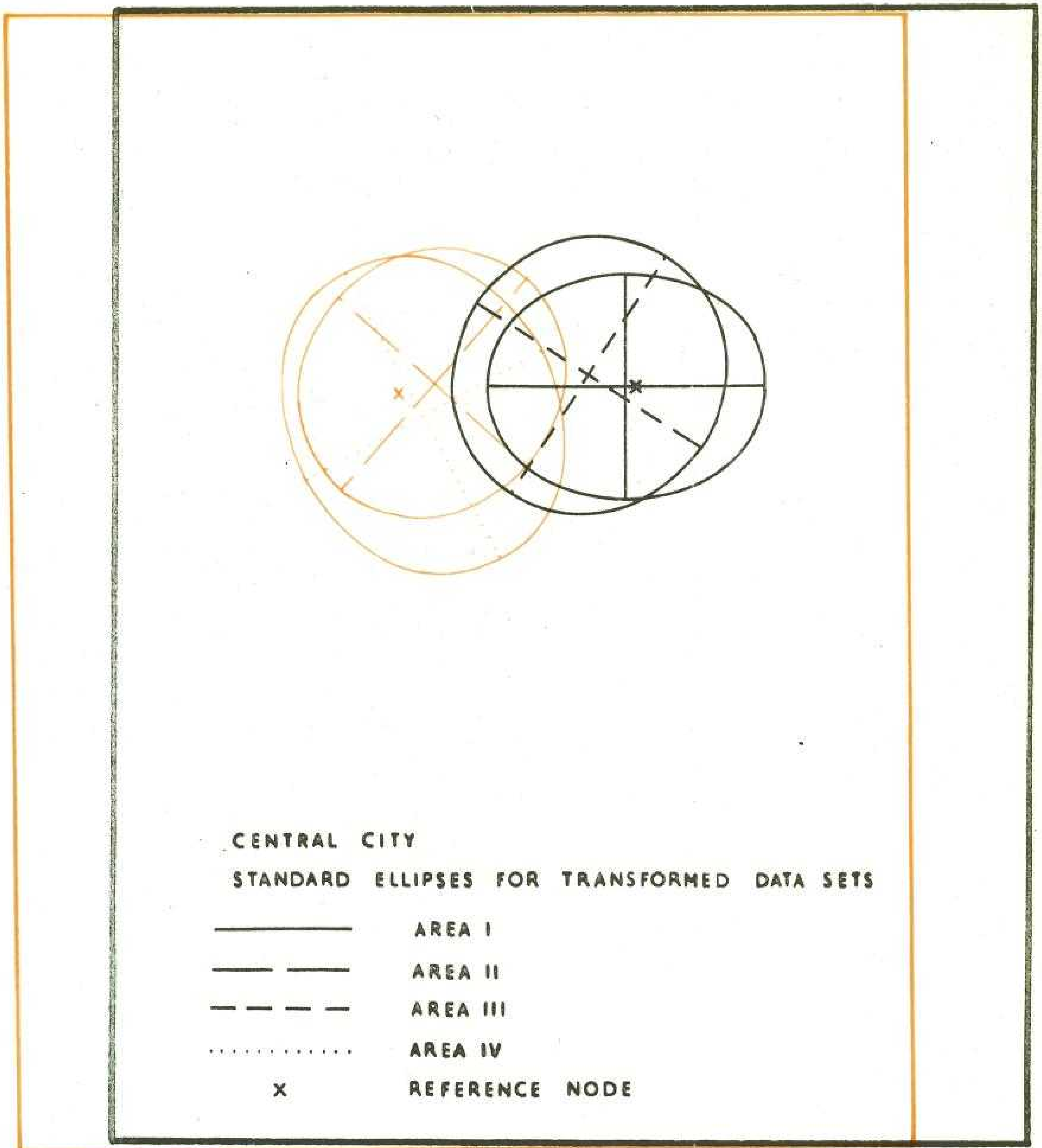

CENTRAL CITY
STANDARD ELLIPSES FOR TRANSFORMED DATA SETS
AREA I
AREA II
AREA III
AREA IV
x REFERENCE NODE

Figure 7

sets. Movements within the central city are less restricted than movements to and from the suburbs by the major thoroughfares. As a result, migrants from the central city do not exhibit preference for short distance moves and for dwellings within a narrow sector centered on the initial dwelling. In short, the awareness space of the migrants is not limited by the existence of barriers.

Aggregative Migration Attributes in the Suburbs

The area of Area V is quite extensive but the percentage of built-up land is small and concentrates in the south-east corner. This is borne out by the statistics of the origins. The mean center is located at the extreme south with clustering around it (see Table 5 and Figure 8). The origins are strung out in a east-west direction. In contrast, the destinations show a direction of distribution at right angles to that of the origins and scatter over a much bigger area. The mean center, on the other hand, is pulled southwards by 2.39 miles from that of the origins. The orientation of the major axis and the location of the mean center suggest that movements are southwards towards the CBD along a major artery, that is, Main Street, which runs north-south through the area. The small angles of rotation and displacement with a very marked displacement of the mean center 2.49 miles west of the reference node indicate a definite bias towards the

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	2.19	12.19	3.19	1.81	0.59	0.89	3.41	15.96	3.1[@]	63.84
Destination	1.06	2.64	6.91	10.06	0.69	3.05		15.49	0.71[@]	37.29
Rotated & Translated	-9.89	-1.15	10.53	6.42	0.61	3.08	-	-2.45	2.49[+]	9.06

TABLE : 5 STATISTICS OF INTRA-URBAN MIGRATION, AREA V

(Sample Size : 36)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

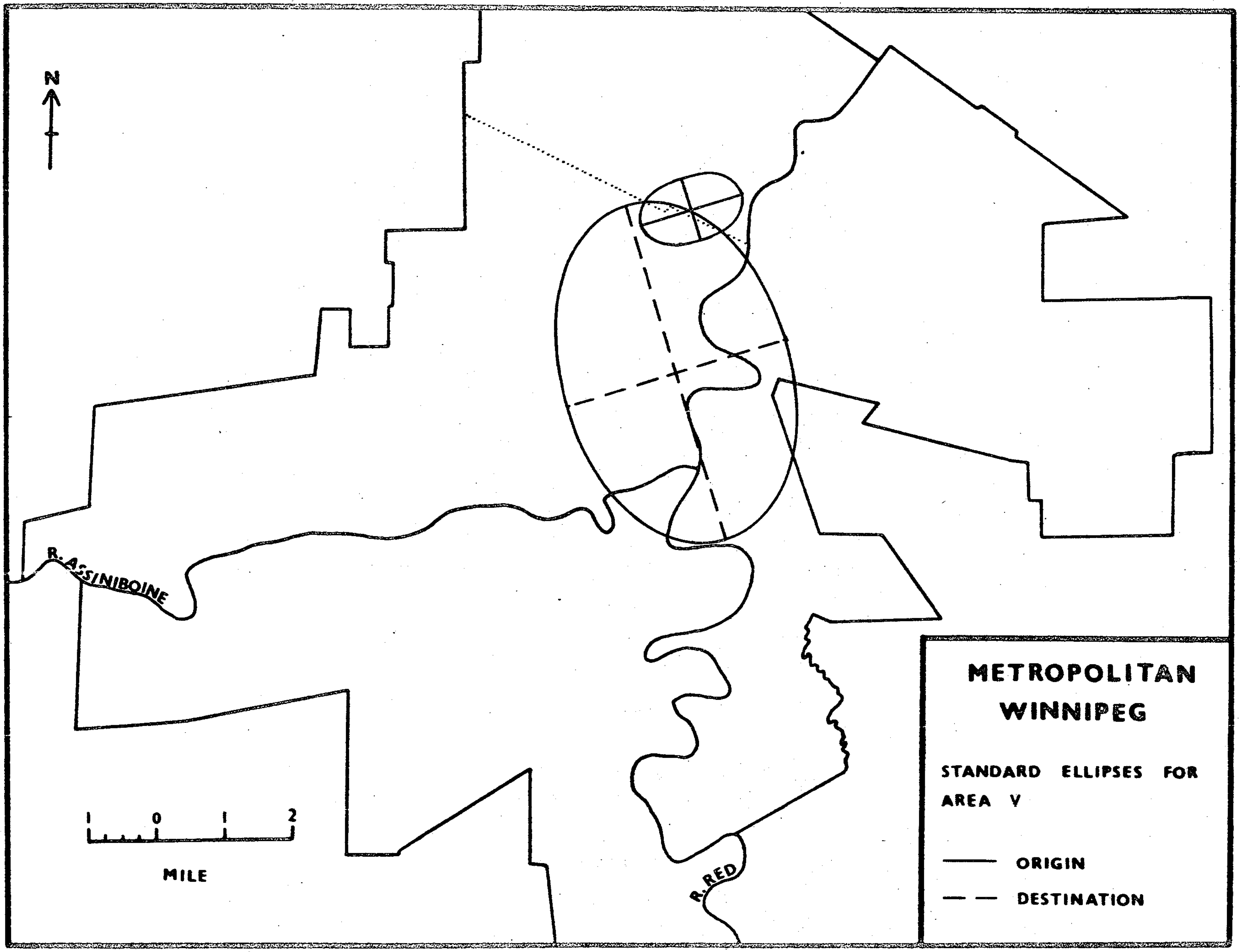

N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA V
ORIGIN
DESTINATION

Figure 8

CBD. A coefficient of circularity of 0.61 contradicts the results for the central city and testifies the fact that movements have occurred near to or along certain lines through the origin. However, similar to the findings for the central city, the migrants do not exhibit preference to relocate near to their original residences.

Area VI is the largest of the all the sub-areas. It includes North and East Kildonan, Elmwood, and Transcona which are mostly built-up. This results in a very large standard radius for the origins, in fact the largest of all the areas. The effect of the size of the area on the statistics are clearly evident. The origins are distributed in a east-west direction complying to the areal long axis. The destinations are also distributed in a east-west direction but its mean center is displaced south-westwards towards the CBD. The orientation of the ellipse of density implies that the destinations are dispersed along the east-west arterial roads (see Table 6 and Figure 9).

The rotated and translated data set substantiates the results for the origin and destination sets. An angle of 0.15° for the attainment of the maximum and minimum standard deviations about the two axes, the small angle of displacement, and a conspicuous negative displacement of the mean center reinforce the attraction of the CBD to the migrants. The coefficient of circularity also connotes the migrants' preference to relocate in areas

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	12.49	6.64	7.48	4.65	0.62	2.2	1.62	20.74	3.52@	6.58
Destination	8.11	1.72	11.96	7.72	0.65	3.56		-15.88	2.07@	27.84
Rotated & Translated	-7.19	-1.57	11.78	6.62	0.56	3.38	-	-0,15	1.84+	12.46

TABLE : 6 STATISTICS OF INTRA-URBAN MIGRATION, AREA VI

(Sample Size : 180)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

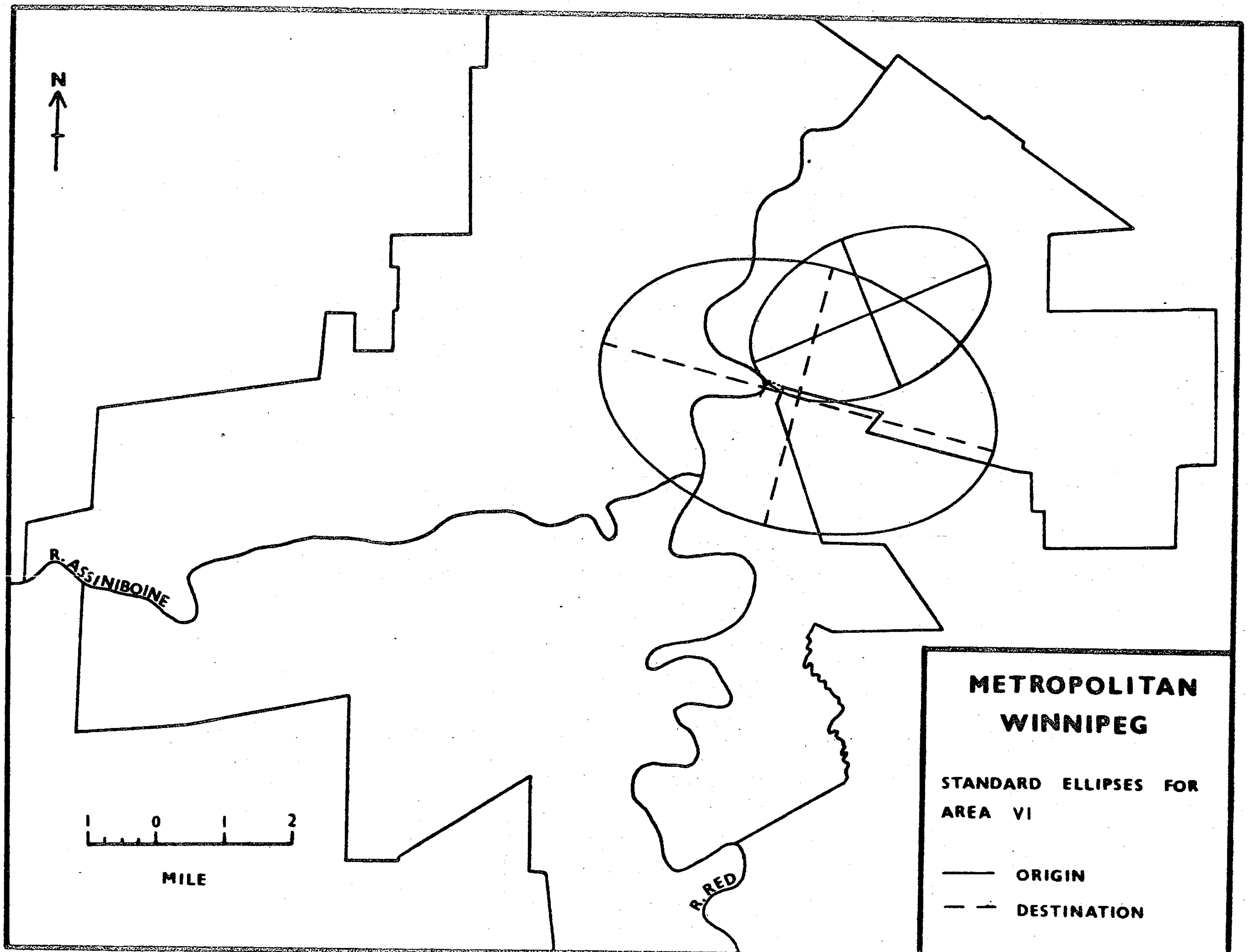

N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA VI
ORIGIN
DESTINATION

Figure 9

near to or along lines through the origin. When migration is CBD oriented, distance bias would be absent as the area lying between the city center and the original residence is within the awareness space so migration can be over long distance. This is the case with Area VI.

Similar to Area II, Area VII is elongated in shape. The origins are distributed in a north-south trend in accordance with the shape of the area (see Figure 10). The mean center is located in the northern section suggesting that most of the moves originated from this part. Scatter around the mean center is not very great (see Table 7). The orientation of the ellipse of concentration for the destinations is nearly at right angles to that of the origins. The orientation of the major axis and the westward shift of the mean center for the destinations suggest that mobility is drawn towards the city center. However, since the mean center usually reflects the location of the most deviant points rather than the more central points, the conclusion with respect to the attraction of the CBD may not be justified.

In contrast to the results for Area V and VI, the moves originated from Area VII do not exhibit directional and sectoral bias. The significance of the large angles of rotation and displacement, 41.6° and 60.3° respectively, and designating movement away from the CBD, is nullified by the negatively displaced mean center. The small difference between the standard deviations about

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	5.6	-7.38	3.17	5.24	0.61	1.53	1.73	-13.88	2.31@	51.04
Destination	2.88	-5.69	8.14	6.81	0.84	2.65		5.39	1.59@	68.55
Rotated & Translated	-3.53	-1.19	7.69	7.49	0.94	2.69	-	41.63	0.93+	60.3

TABLE : 7 STATISTICS OF INTRA-URBAN MIGRATION, AREA VII

(Sample Size : 201)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

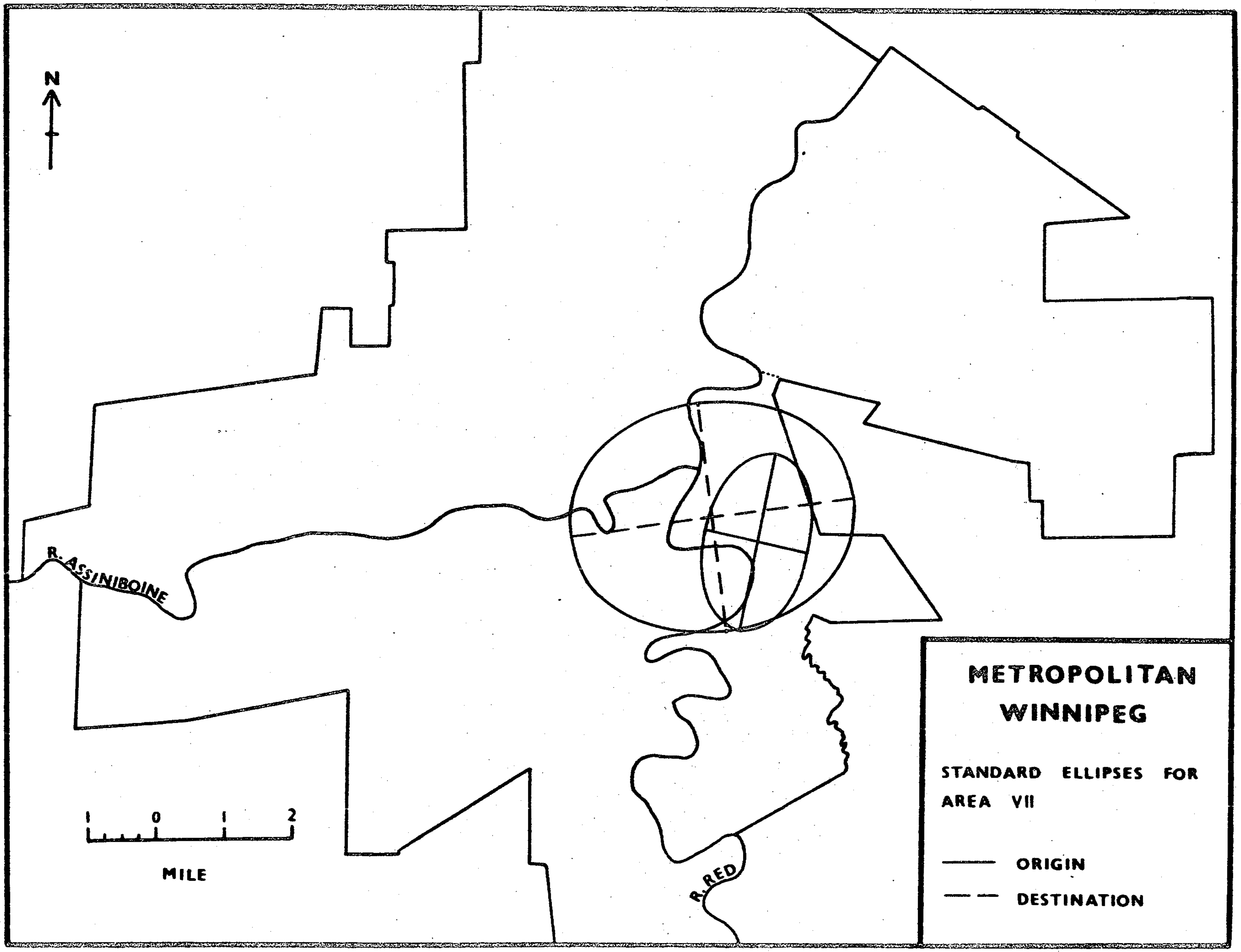

N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR
AREA VII
ORIGIN
DESTINATION

Figure 10

the X- and Y-axis offers no evidence for sectoral bias. Distance bias, as usual, is absent.

In Area VIII, the distribution of the origins also reflects the influence of the shape of the area, and is in a north-south direction following the areal long axis, (see Table 8 and Figure 11). No inferences can be made about the locale of the migrants before relocation because the statistics might have arisen out of an even distribution. The destinations have a distribution similarly oriented. As these are not necessarily located inside the area, remarks can be made that the destinations are slightly linearly arranged. The northward displacement of the mean center of the destinations suggests movements are towards the city center. From the rotated and translated data set, the small angles of rotation and displacement and a negatively displaced mean center help to confirm the migrants' preference for locations nearer the city center. However, the coefficient of circularity and standard radius do not support the popular notion that migrants are limited areally in the choice of new location and prefer vacancies closer to the initial residence.

For the data from Area X, both the origins and the destinations are distributed linearly in a east-west direction. While the origins cluster around their mean center, the destinations scatter over a large area (see Table 9 and Figure 12). Moreover, the latter mean center is

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-2.21	-18.49	4.68	6.22	0.75	1.95	1.7	3.59	4.66@	10.42
Destination	-2.15	-11.98	8.2	10.41	0.79	3.31		2.16	3.04@	12.33
Rotated & Translated	-6.95	-0.82	10.66	7.86	0.74	3.31	-	5.37	1.75+	1.37

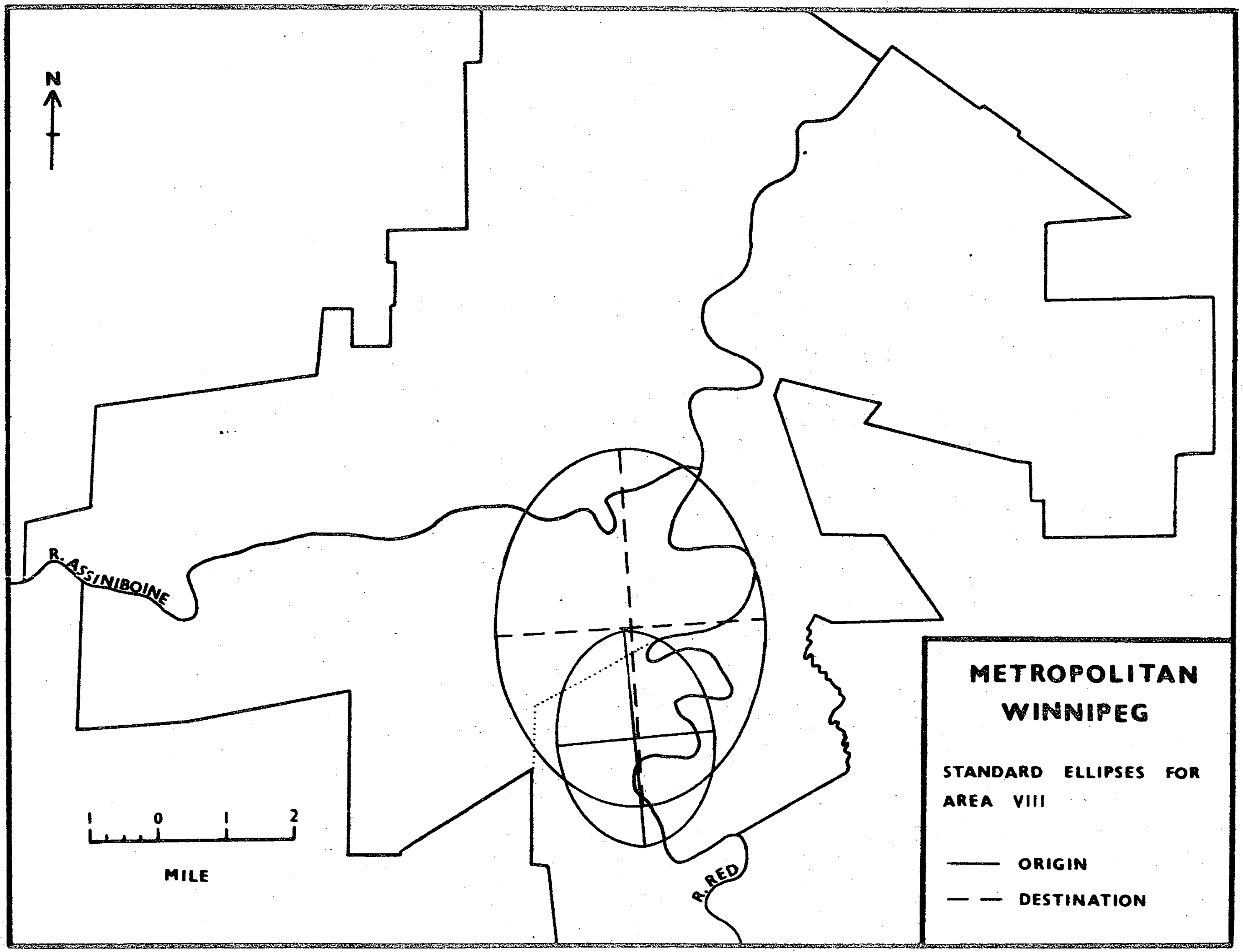
TABLE : 8 STATISTICS OF INTRA-URBAN MIGRATION, AREA VIII

(Sample Size : 47)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.


N
R. ASSINIBOINE
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2
MILE
R. RED
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA VIII
ORIGIN
DESTINATION

Figure 11

also pulled considerably towards the center of the city. Return movements from the suburbs are suggested. The orientation of the ellipses of concentration for both the origin and destination sets implies that migrants are from well defined sectors. In reality, there is a concentration of apartment buildings along the main arterial road, Portage Avenue (see Figure 14). It is expected that more of the moves constitutes apartment dwellers than of single family house occupants. The desire to move back to the city is further asserted by the very small angle of rotation and the small angle of displacement plus the negatively displaced mean center. Return movements to the city does not necessitate short distance migration as the migrants have adequate knowledge of the area throguh their daily activities.

The results of analysis of migrants from the suburbs are quite different from that of the central city. Movements from the suburbs are definitely attracted towards the CBD and confined within narrow sectors with the exception of Area VII (compare the last row of Tables 5 to 9, and see Map 13). Return movements are expected to follow the major thoroughfares which are much used for performing daily activities and subsequently forms the reference axis for searching new residences. The lack of conformity of migration from Area VII is tentatively a result of the high degree of segregation exhibited by

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-20.33	-3.25	6.29	3.67	0.58	1.82	1.75	-22.59	5.16[@]	31.67
Destination	-15.27	-2.85	11.27	5.9	0.52	3.18		-10.68	3.88[@]	21.23
Rotated & Translated	-5.46	0.29	10.2	5.82	0.57	2.94	-	0.36	1.37[+]	3.35

TABLE : 9 STATISTICS OF INTRA-URBAN MIGRATION, AREA X

(Sample Size : 129)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

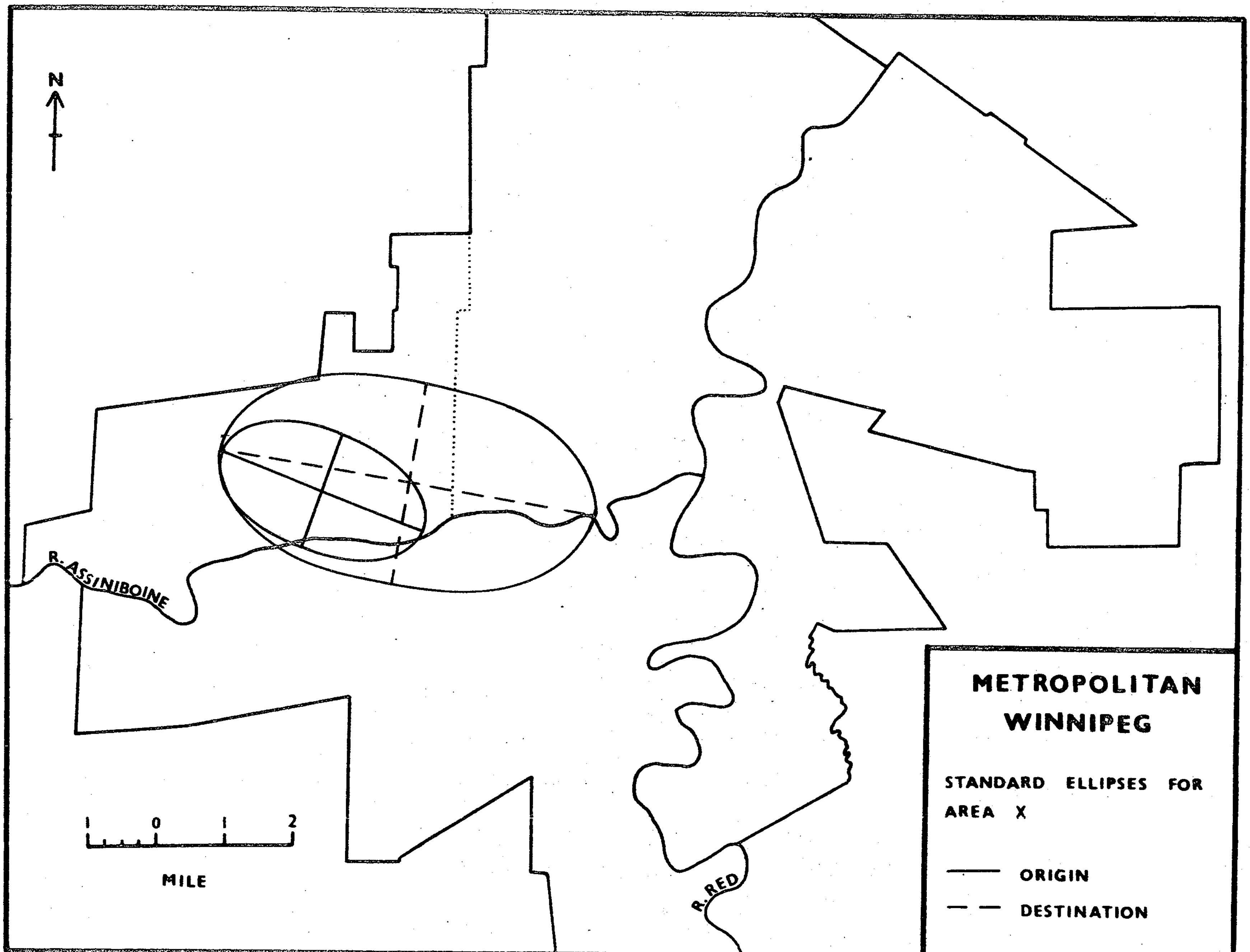
N
R. ASSINIBOINE
R. RED
1 0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR AREA X
ORIGIN
DESTINATION

Figure 12

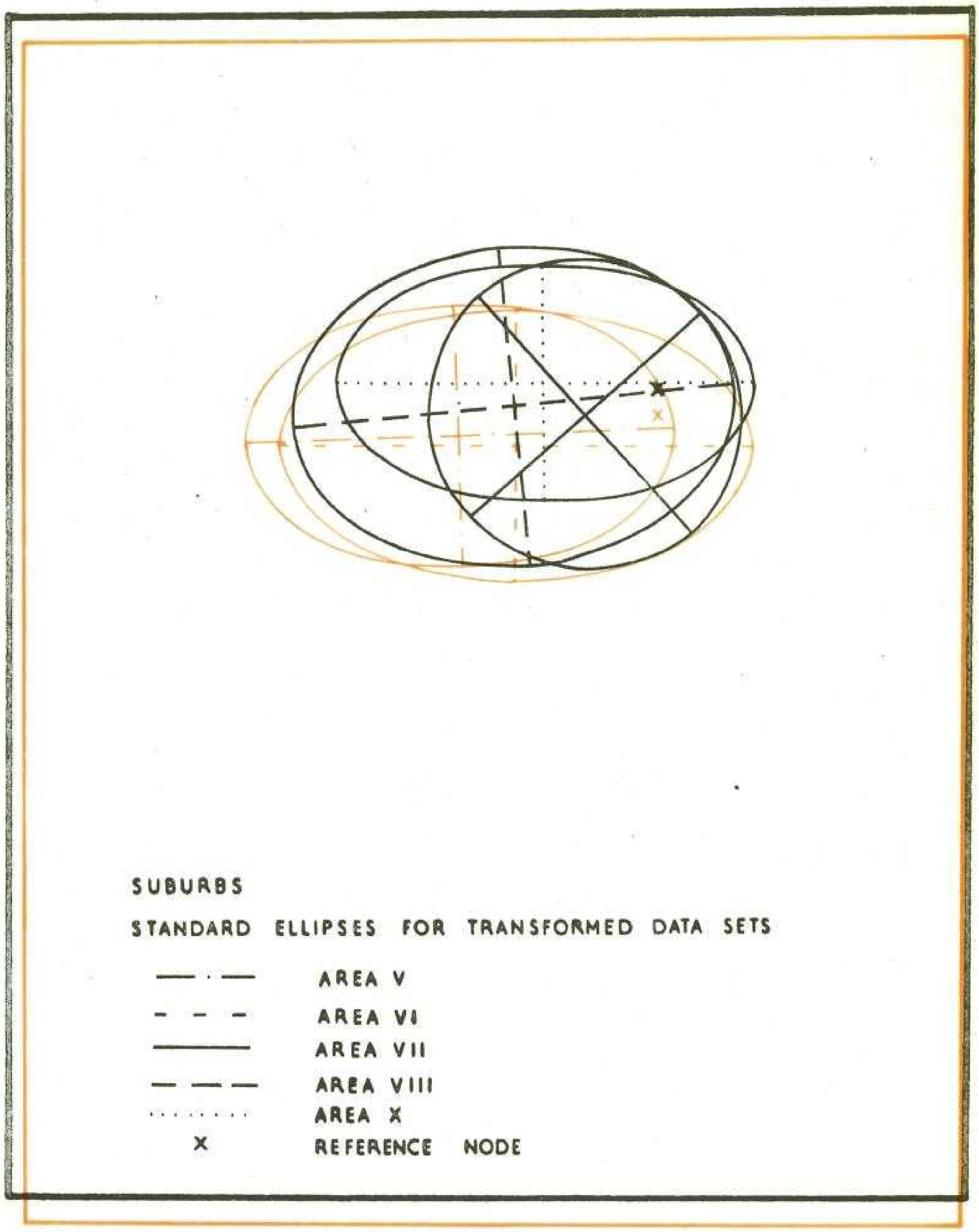
SUBURBS
STANDARD ELLIPSES FOR TRANSFORMED DATA SETS
AREA V
AREA VI
AREA VII
AREA VIII
AREA X
x REFERENCE NODE

Figure 13

St. Boniface.[12] Movements may be largely within the area itself. The presence of a few deviant points shifts the location of the mean center. In spite of the differences in the results between areas from the suburbs and those from the central city, the postulate that migrants are hindered by the presence of physical and social barriers in relocation cannot be established in the suburbs as well. In all the areas, there are movements across the boundary into adjacent zones, as the ellipse of density, supposedly embodying 40% of the points,[13] lies partly outside the origin area.

In conclusion, the concept of the flight to the suburbs cannot be affirmed for migrants from the central city. These migrants are also not confined within a narrow sector of the city when relocating. On the other hand, there are considerable return movement from the suburbs. The migrants also exhibit definite preference to relocate nearer to the city center and in dwellings within a narrow sector centered on the initial dwelling. In both the central city and the suburbs, physical and social barriers are ineffective in limiting movements.

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[12] Baxter, op. cit.

[13] Lee, op. cit. p.50.

CHAPTER V

APPLICATION OF THE METHODS TO MOVE TYPES

In Chapter IV it has been shown that there is a difference between residential mobility from the central city and that from the suburbs. Further, it was shown that the geographic elements of mobility from the central city did not have definite patterns while mobility from the suburbs, on the other hand, occurred within well defined sectors and oriented towards the CBD. The data were grouped according to areas to which the initial dwelling belonged. Each area might have included migrants from differenct dwelling types. The type of dwelling sought, however, should have some influence on the resultant distance, direction, and sectoral attributes. The possible influence of these variables are examined in the following discussion.

Residential structures in the city can be grouped into two main categories : (1) single family dwellings, and (2) multiple family dwellings which include both apartment-flats and rooming houses. The first type is a low density residential land use while the latter is a high density one. Besides the difference in the number of persons housed per unit area of land, their distribution within the city is also different. Single family dwellings are usually found in the suburbs while apartments and rooming houses are located nearer to the city center. In Winnipeg, approximately fifty percent of all apartment units are found within a one-and-one-quarter mile radius from the intersection of the Portage Avenue and Memorial Boulevard.[1] All other major concentrations are along the main roads. The majority of intra-urban migration ends in pre-existing dwellings, vacated by other families.[2] Moving into apartments and rooming houses should therefore, show orientation towards the city center and moving into houses should be directed away from the city center.

Besides this difference in areal distribution, these two dwelling categories also offer different tenures. The majority of single family houses are owner-occupied while apartments are invariably rental properties. Intuitively, moving into an owner-occupied dwelling would certainly involve greater capital investment than into a rental property. Consequently, it might be expected that more effort will be devoted to searching for a dwelling which can better satisfy the household needs. Rossi in his study of Philadelphia has found that a greater percentage of owners than renters have looked at more than

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[1] Analysis of Apartments in Metropolitan Winnipeg, op. cit. See Figure 14.

[2] Heiges, op. cit.

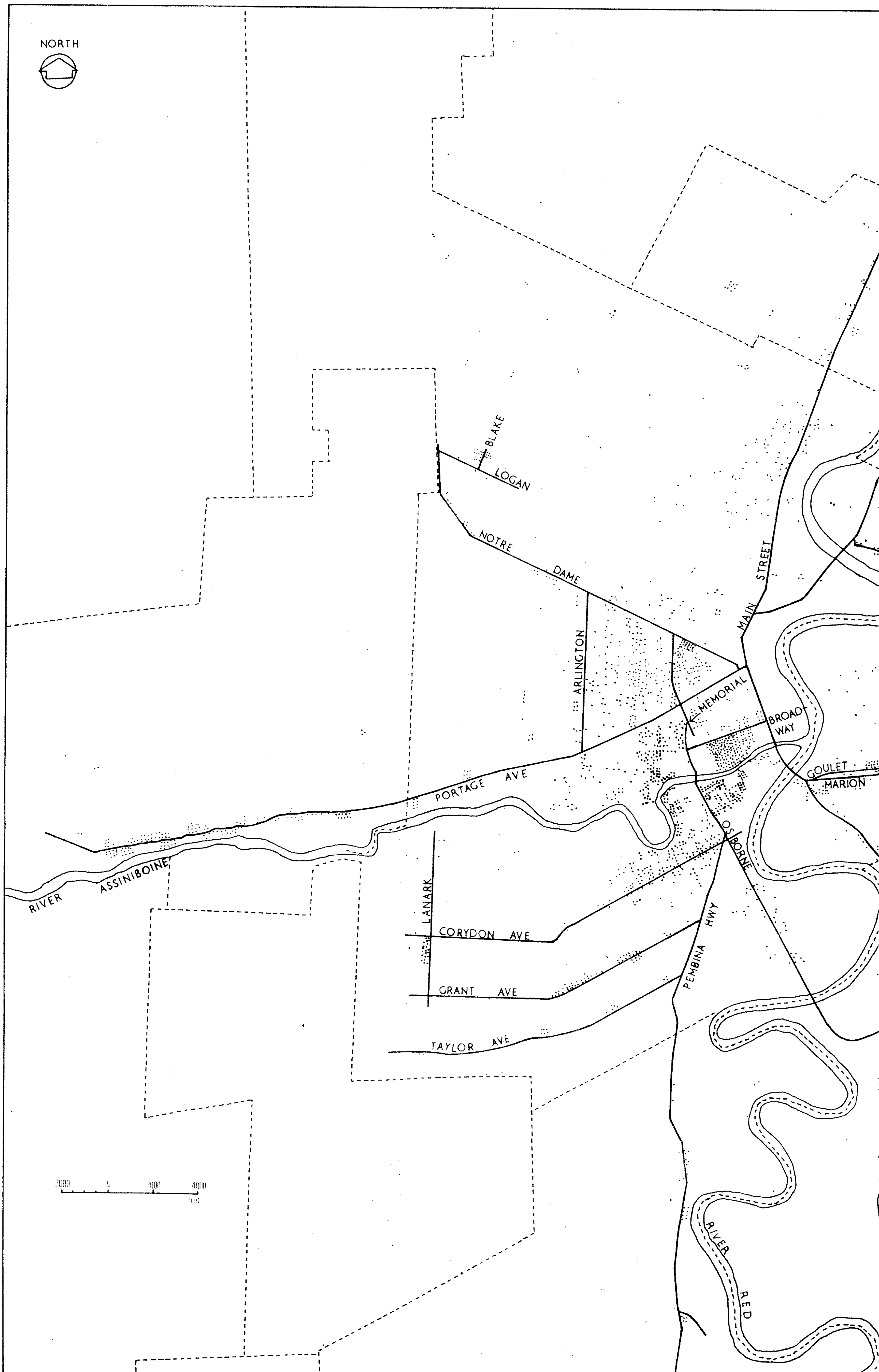
NORTH
BLAKE
LOGAN
NOTRE
DAME
MAIN
STREET
ARLINGTON
MEMORIAL
BROAD-
WAY
GOULET
MARION
PORTAGE AVE
RIVER
ASSINIBOINE
OSBORNE
LANARK
CORYDON AVE
GRANT AVE
TAYLOR AVE
PEMBINA HWY
RIVER
RED
2000
0
2000
4000
feet

Figure 14

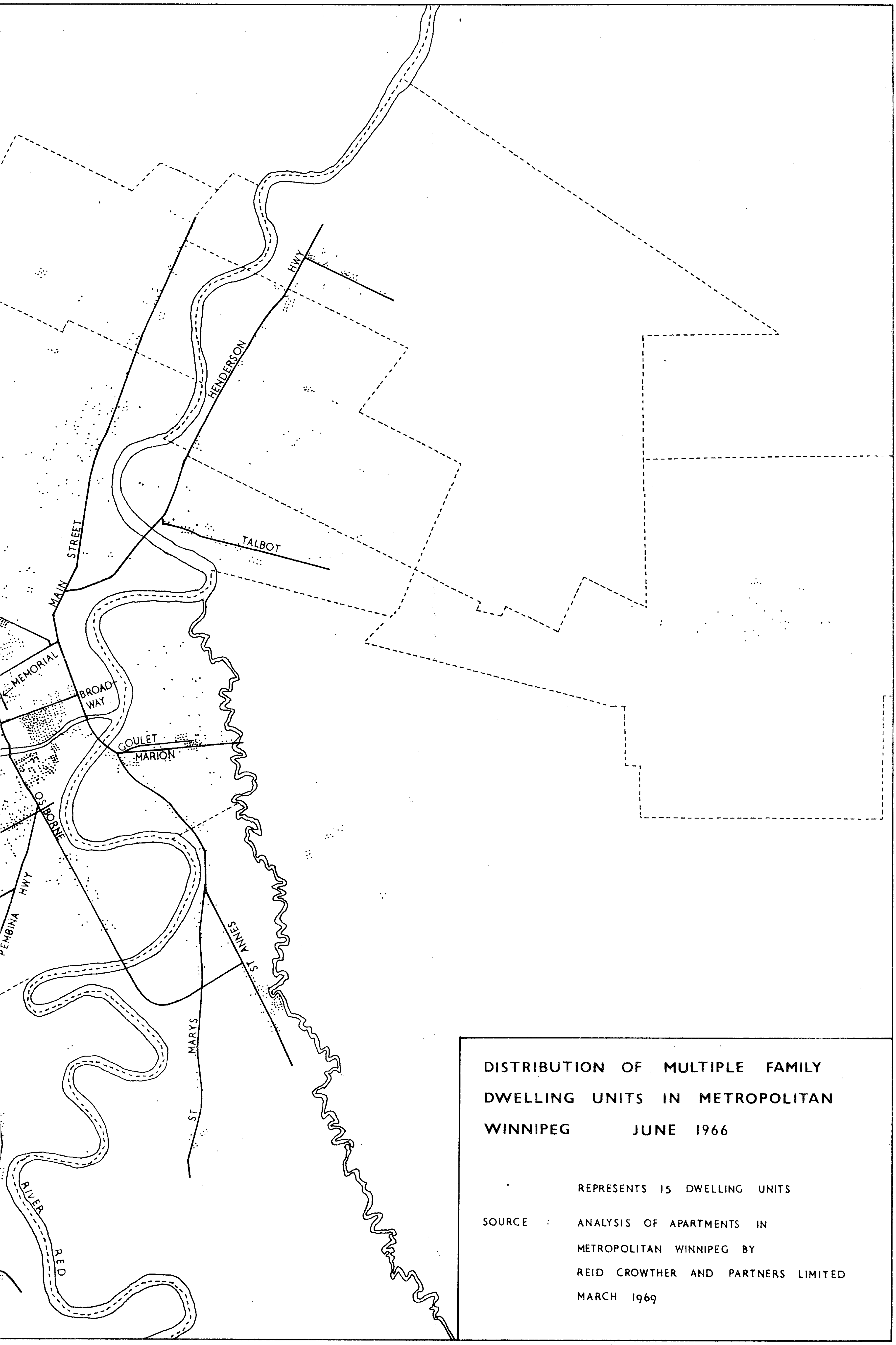
HWY
HENDERSON
MAIN STREET
TALBOT
MEMORIAL
BROADWAY
GOULET
MARION
OSBORNE
PEMBINA HWY
ST ANNES
ST MARYS
RED RIVER
DISTRIBUTION OF MULTIPLE FAMILY DWELLING UNITS IN METROPOLITAN WINNIPEG JUNE 1966
REPRESENTS 15 DWELLING UNITS
SOURCE : ANALYSIS OF APARTMENTS IN METROPOLITAN WINNIPEG BY REID CROWTHER AND PARTNERS LIMITED MARCH 1969

Figure 14

one place before making the final decision.[3] It has also been mentioned in Chapter II that the migrant's mental image would change with the length of time devoted to searching for a new residence. If the mental image plays an important role in determining the site chosen, the mobility patterns of migrants into owner-occupied and rental properties would not be the same. Further, different types of dwellings offer different living environments. The move into different dwelling types can be regarded as different types of activity.[4] The resultant mobility pattern therefore should be different.

A further basis for expecting mobility into different dwelling types to exhibit different patterns is the changes in preference for dwelling types as the family progresses through its life cycle. Rossi from his intensive survey and follow-up interviews concluded that "the major function of mobility [is] the process by which families adjust their housing to the housing needs that are generated by the shifts in family composition that accompany life cycle changes."[5] Non-family households and young families without children tend to stay in apartments and rooming houses. On the other hand, families with young children prefer

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[3] Rossi, op. cit. p.163.

[4] This is analogous to Nystuen's types of activities carried on an isotropic plain. Nystuen, op. cit.

[5] Rossi, op. cit. p.9.

single family houses in a suburban setting as apartments are not conducive to child-rearing. Families in late life cycle, however, tend to move back to apartments which are nearer to all facilities and where maintenance is less than for houses. The different moves associated with the transition from one stage in the family life cycle to another would exhibit different patterns as the distribution of dwelling types is not uniform.

It was shown above that the type of housing sought determines to a certain extent the mobility patterns. Housing types are therefore grouped into three categories, and the data are then classified according to the house type of both the origin and the destination. The three housing categories are :-

(1) House -- which would include a single detached house, a semi-detached house and a duplex.[6]

(2) Apartment -- which would include all dwelling types except house and rooming house.

(3) Rooming House -- which has been converted into multiple household structure from single family dwelling.

Since the data are classified according to the dwelling type of both the origin and destination, nine move types

---

[6] For the definitions of single detached house, semi-detached house, duplex, and apartment, see Census of Canada, 1961, Vol. 2, part 2.

are identified. They are : I. from House to House, II. from House to Apartment, III. from House to Rooming House, IV. from Apartment to Apartment, V. from Apartment to House, VI. from Apartment to Rooming House, VII. from Rooming House to Rooming House, VIII. from Rooming House to House, IX. from Rooming House to Apartment.

Move Types I, V, and VIII involve the selection of a house. According to Adams,[7] migrants of these move types would move over a shorter distance within a well defined sector and are oriented away from the CBD. Move Type II contains moves from a house to an apartment and is similar to moves undertaken by families in their late life cycle. Consequently this move type is hypothesized to exhibit orientation towards the CBD with no distance and sectoral bias. The same would also be expected from Move Types IV and IX because the majority of apartments are located near to the center of the city. On the other hand, Move Types VI and VII contain moves to a rooming house. Rooming houses are limited in extent and located near the business center. As a result, these two move types would show preference to locations nearer to the CBD and to a short distance move. Results of Move Type III is not presented because it contains a very small number of migrants (6).

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[7] Adams, *op. cit.*

The original residence is the node from which activities, such as journey to work, social visits, and shopping trips, are being carried out. However, it is hypothesized that the type of housing sought determines the mobility pattern. As a result, move types with the same dwelling type as destinations are discussed together.

The distribution patterns of the origins and destinations of the move types ending in a house are very similar to each other except the origins of Move Type VIII (see Tables 10 -- 12 and Figures 15 -- 18). They are distributed in an east-west direction which is also the direction of the major axis of the study area. Dispersion around the mean centers is substantial as the standard radii are longer than three miles except for Move Type VIII. Relative dispersion is not great. As for Move Type VIII, the north-south orientation of the origins is distinguishable even though the coefficient of circularity is near unity. Such a distribution pattern results from the fact that rooming houses occur invariably in and around the business center.

The results of the analysis of the rotated and translated data do not substantiate the hypothesized pattern. The preferred direction of mobility is inward towards the business center. The concept of the 'flight to the suburbs' does not apply to migrants moving into houses. Since movements are not towards the outer fringe of the urban

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-2.35	-1.71	10.97	8.79	0.80	3.52	1.13	-23.03	0.73@	59.04
Destination	-2.54	-2.39	13.21	8.81	0.67	3.97		-15.89	0.87@	59.13
Rotated & Translated	-3.02	-0.29	9.58	7.56	0.79	3.05	-	10.04	0.76+	4.9

TABLE : 10 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE I

(Sample Size : 395)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-0.24	-1.06	10.20	7.35	0.72	3.14	1.13	-17.06	0.27@	94.11
Destination	-2.24	-1.32	11.74	8.05	0.69	3.56		-12.54	0.65@	42.98
Rotated & Translated	-3.23	-1.05	9.75	7.85	0.80	3.12	-	7.97	0.85+	10.05

TABLE : 11 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE V

(Sample Size : 270)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-1.81	-0.04	5.48	5.97	0.92	2.03	1.35	28.04	0.45@	116.74
Destination	-2.70	-0.33	8.68	6.65	0.77	2.73		-22.96	0.68@	29.88
Rotated & Translated	-1.94	-0.32	7.80	6.55	0.84	2.55	-	-10.35	0.49+	19.57

TABLE : 12 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE VIII

(Sample Size : 195)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

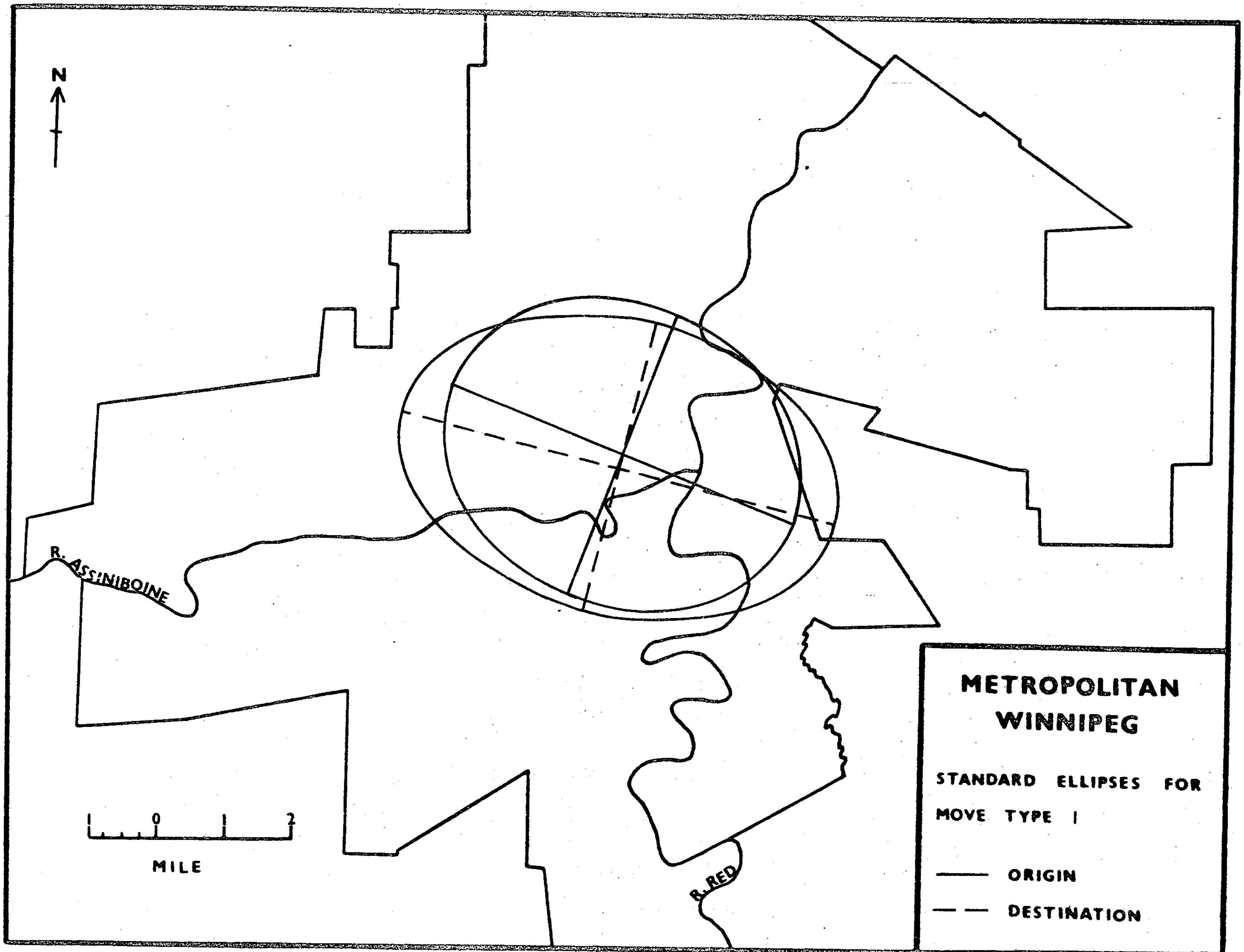
N
R. ASSINIBOINE
R. RED
0
1
2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR MOVE TYPE 1
ORIGIN
DESTINATION

Figure 15

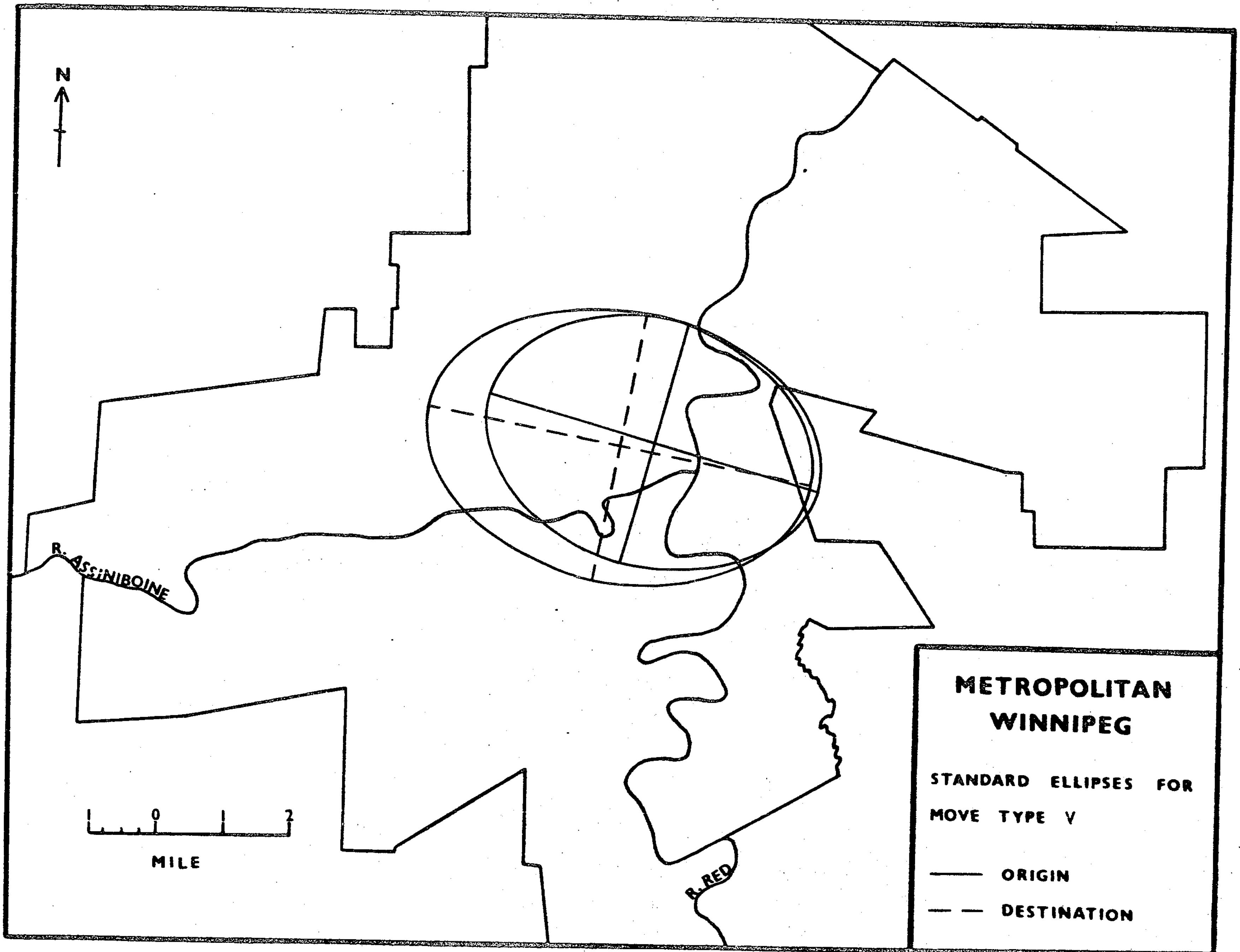
N
R. ASSINIBOINE
R. RED
0
2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR MOVE TYPE V
ORIGIN
DESTINATION

Figure 16

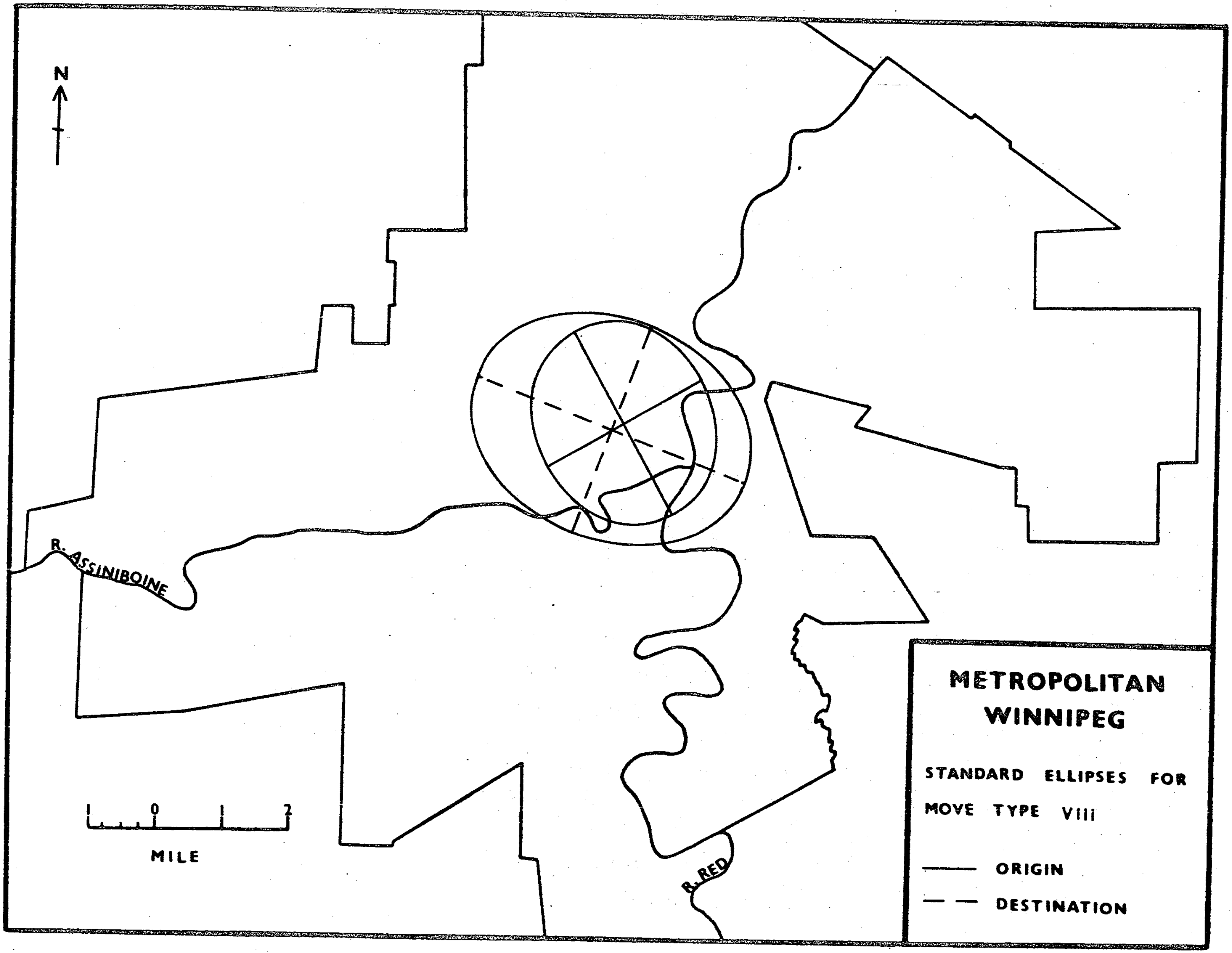
N
R. ASSINIBOINE
R. RED
0
2
MILE
METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR
MOVE TYPE VIII
ORIGIN
DESTINATION

Figure 17

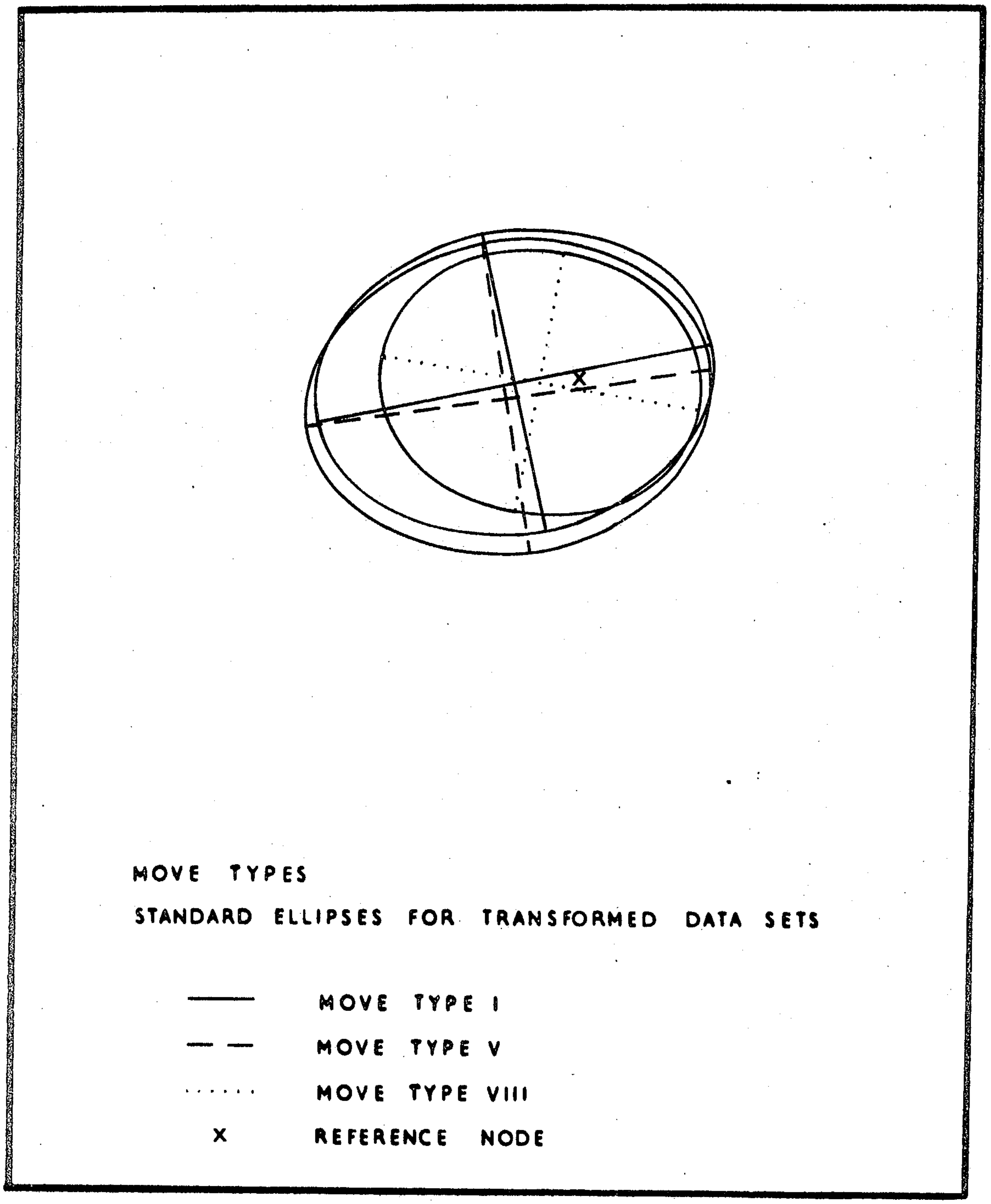
MOVE TYPES
STANDARD ELLIPSES FOR TRANSFORMED DATA SETS
MOVE TYPE I
MOVE TYPE V
MOVE TYPE VIII
X REFERENCE NODE

Figure 18

area, the distance and sectoral bias would not occur.[8] A longer search period for a suitable house would also reduce the possibilities of relocating in a nearby vacancy within well defined sectors centered on the origin because of the enlargement of the awareness space through time.

The pattern of distribution for both the origin and destinations of Move Types II, IV, and IX are identical to that of Move Types I, V, and VIII (see Tables 13 -- 15 and Figures 19 -- 22). The initial residence of Move Type IX, like that of Move Type VIII, is rooming house and also has the same direction of distribution. The destination sets of Move Types IV and IX scatter over a greater area than the origin sets. However, the reverse is true for Move Type II. This move type contains migrants from house to apartment. Since houses are distributed more evenly throughout the study area and the majority of apartments are found in and near the business center, the destination set should be more clustered. The scatter of both the origin and destination sets of Move Type IX is not as great as the other two (see Tables 13 -- 15).

The results of analysis for the rotated and translated data set for movements into houses can well be applied to Move Types II, IV, and IX. However, the implications

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[8] This is because migrants have adequate knowledge about the area between their former residences and the CBD.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-2.18	-1.09	11.45	7.89	0.69	3.48	0.95	-17.50	0.61[@]	44.31
Destination	-2.02	-1.80	10.50	7.93	0.76	3.29		-16.33	0.68[@]	58.13
Rotated & Translated	-5.12	0.27	9.01	6.77	0.75	2.82	-	3.97	1.28[+]	6.93

TABLE : 13 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE II

(Sample Size : 136)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-1.81	-2.41	8.36	6.79	0.81	2.69	1.16	-20.35	0.75@	73.41
Destination	-1.98	3.06	9.77	7.73	0.79	3.11		-9.76	0.91@	67.80
Rotated & Translated	-2.54	-0.31	8.49	6.93	0.82	2.74	-	-9.82	0.64+	16.78

TABLE : 14 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE IV

(Sample Size : 366)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-2.15	-1.98	4.41	5.01	0.88	1.67	1.36	13.58	0.73[@]	60.99
Destination	-1.84	-1.48	7.07	5.65	0.80	2.26		0.29	0.59[@]	38.46
Rotated & Translated	-2.71	-1.21	6.63	6.3	0.95	2.29	-	5.87	0.74[+]	18.29

TABLE : 15 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE IX

(Sample Size : 121)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

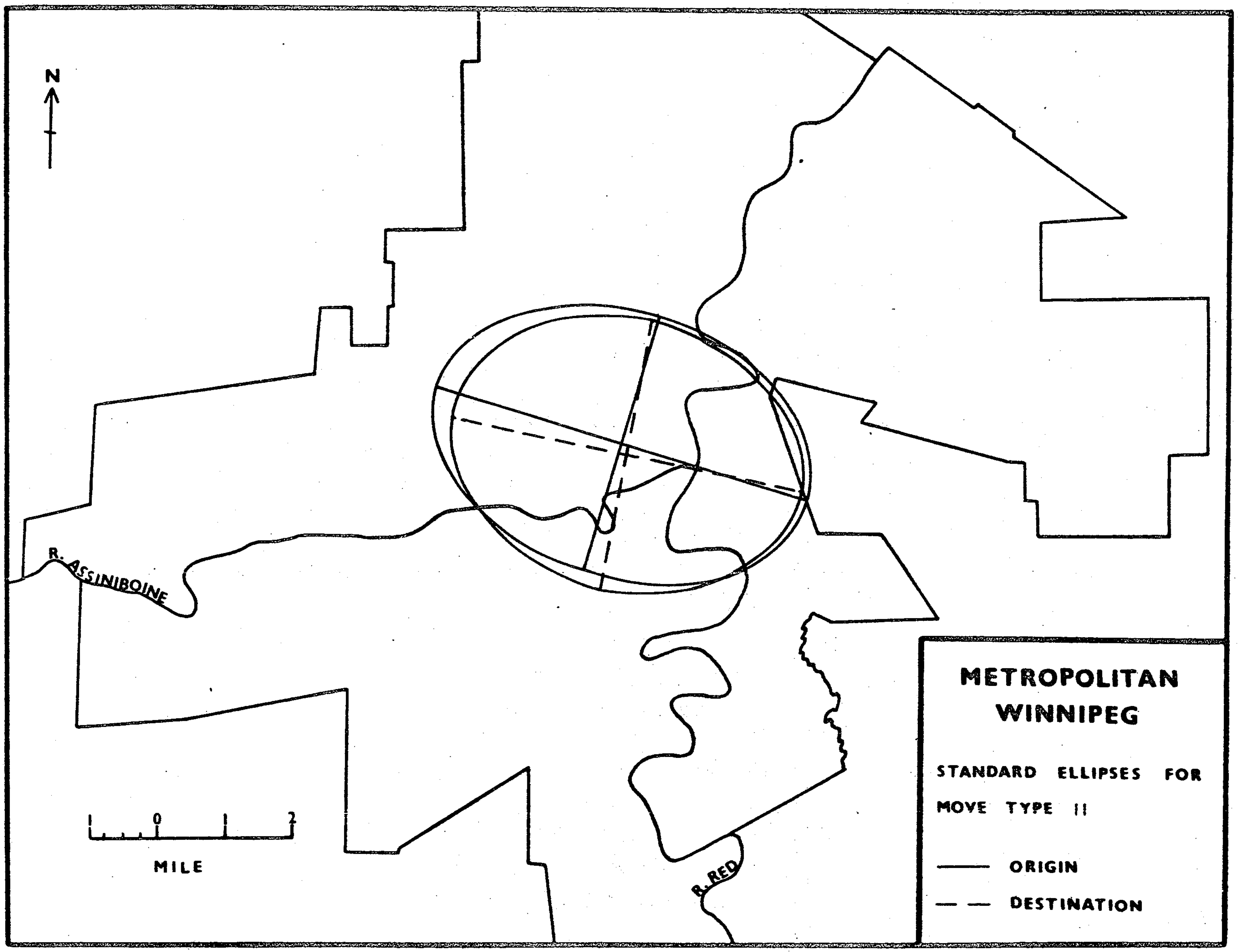
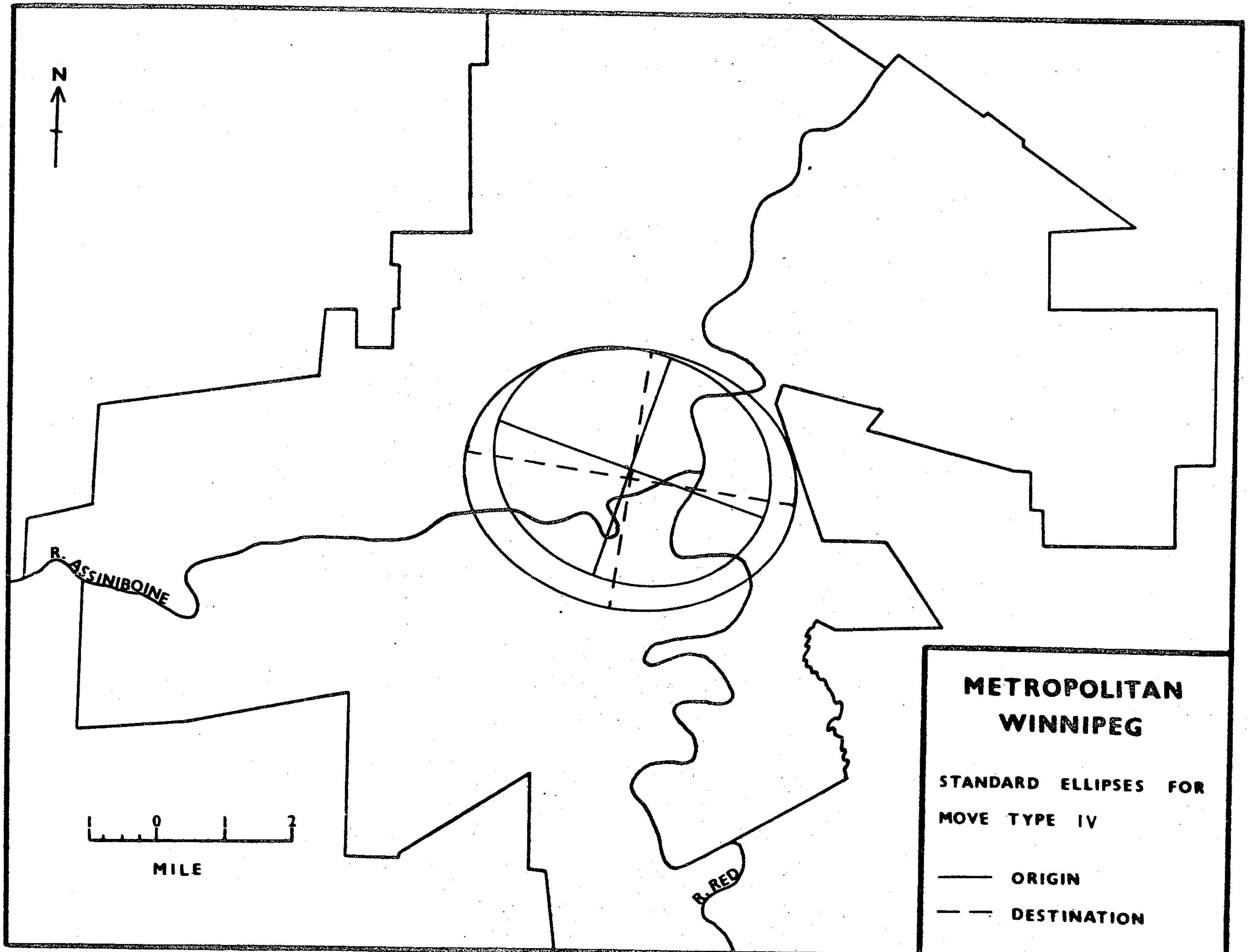

N
R. ASSINIBOINE
R. RED
0
1
2
MILE
METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR
MOVE TYPE II
ORIGIN
DESTINATION

Figure 19



N
R. ASSINIBOINE
R. RED
0
1
2
MILE
METROPOLITAN
WINNIPEG
STANDARD ELLIPSES FOR
MOVE TYPE IV
ORIGIN
DESTINATION

Figure 20

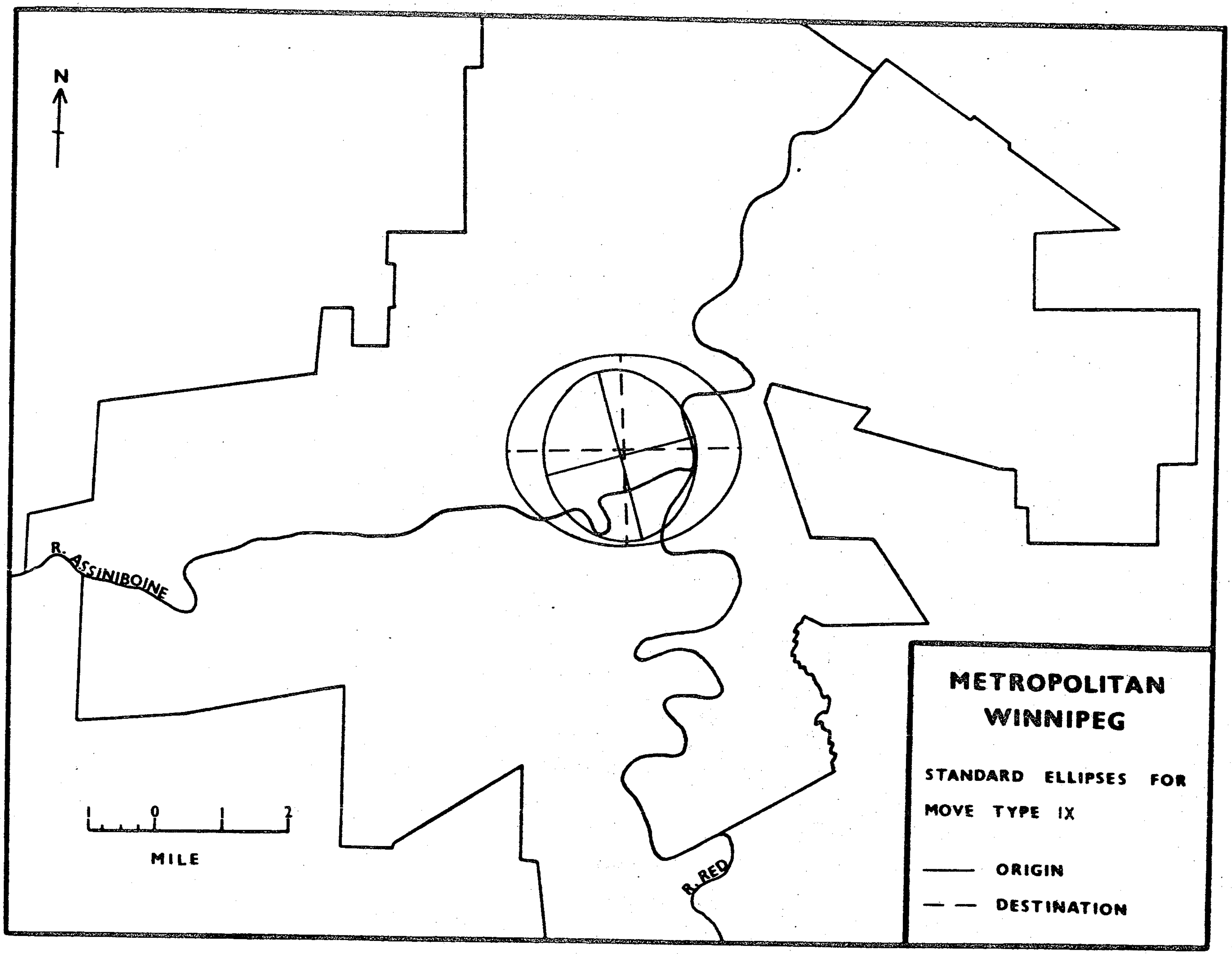
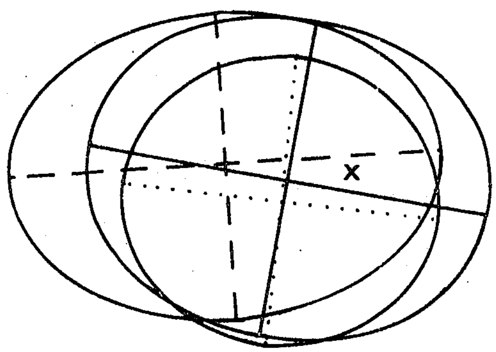

N
R. ASSINIBOINE
R. RED
0 1 2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR MOVE TYPE IX
ORIGIN
DESTINATION

Figure 21



MOVE TYPES

STANDARD ELLIPSES FOR TRANSFORMED DATA SETS

— — MOVE TYPE II

——— MOVE TYPE IV

. . . . . . MOVE TYPE IX

X REFERENCE NODE

Figure 22

are different. In the latter case, the destinations are in apartments which are concentrated in and near the CBD. Mobility should, therefore, be oriented towards the CBD and conform to the hypothesized orientation. The scatter around the mean center is also less than those of the movements into houses. Even though apartments are found mostly along major thoroughfares, movements within apartments are not confined within narrow sectors.

The pattern of distribution of Move Types VI and VII are very different from those with destinations in houses or in apartments (see Tables 16 and 17, and Figures 22 -- 24). The origins and destinations show a marked north-south orientation, similar to the origins of Move Types VIII and IX. In both of these cases the direction of orientation is more distinct because the coefficient of circularity is small. The clustered nature of this house type is also manifested by the small standard radius. The destinations in both cases cluster closer than the origins. This may be a result of the decreasing supply of rooming houses through urban renewal and redevelopment.

The rotated and translated data for these two move types also display differences when compared with the others. Distance, direction, and sectoral biases are all exhibited. The origin and destination sets have already illustrated that the rooming houses are limited in areal extent. As a result, the move from one to another rooming house would be over short distances. The location of

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-0.07	-0.17	4.63	6.70	0.69	2.04	0.92	-0.64	0.05[@]	67.56
Destination	-0.90	1.03	4.03	6.31	0.64	1.87		-14.14	0.34[@]	34.95
Rotated & Translated	-2.68	0.42	5.16	3.45	0.67	1.55	-	5.6	0.68[+]	14.41

TABLE : 16 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE VI

(Sample Size : 29)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

Data Set	Location of Mean Center*		Standard Deviation About		Coef. of Circularity	Standard Radius (Mi.)	Relative Standard Radius	Angle of Rotation	Displacement	
	X-axis	Y-axis	Y-axis	X-axis					Distance (Mi.)	Angle
Origin	-1.71	0.44	4.75	4.06	0.85	1.56	0.82	-27.99	0.44[@]	13.63
Destination	-3.4	0.23	3.28	3.94	0.83	1.28		31.53	0.85[@]	35.39
Rotated & Translated	-1.46	-0.13	4.89	3.0	0.61	1.44	-	3.09	0.37[+]	1.92

TABLE : 17 STATISTICS OF INTRA-URBAN MIGRATION, MOVE TYPE VII

(Sample Size : 48)

*The origin of the coordinates is at the center of the CBD.

@This is the distance of the mean center from the center of the CBD.

+This is the distance of the mean center from the reference node.

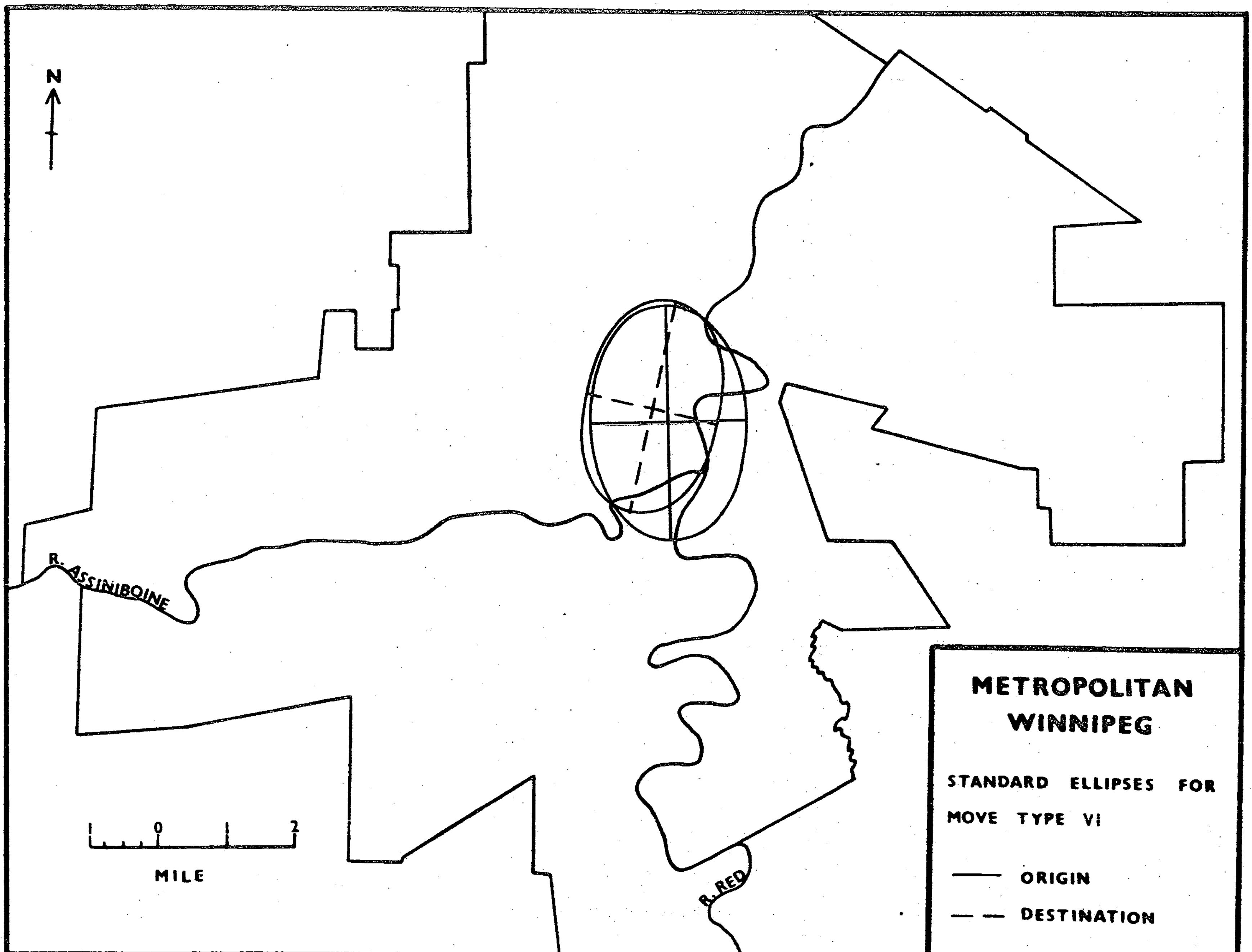

N
R. ASSINIBOINE
R. RED
0
2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR MOVE TYPE VI
ORIGIN
DESTINATION

Figure 23

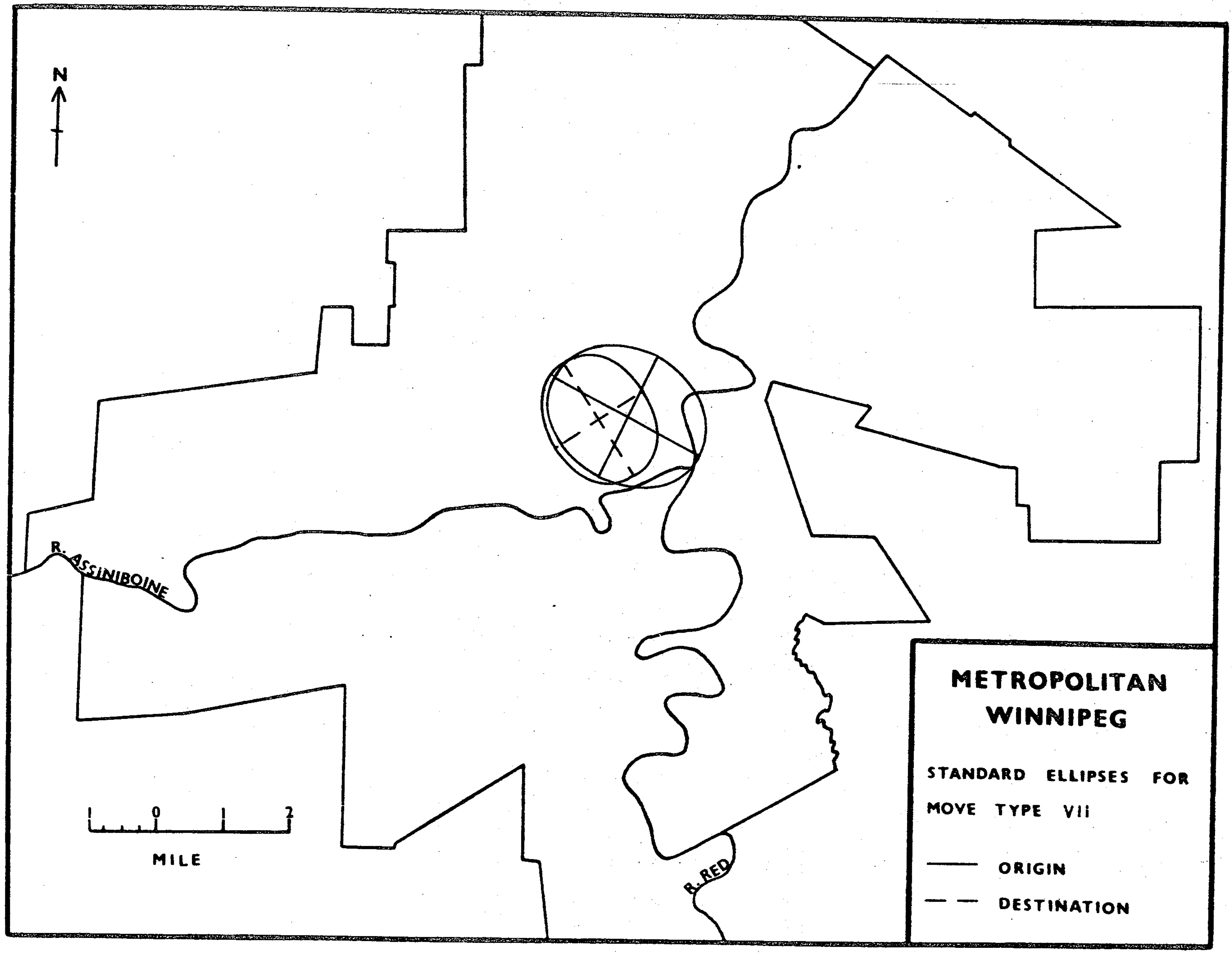

N
R. ASSINIBOINE
R. RED
0
1
2
MILE
METROPOLITAN WINNIPEG
STANDARD ELLIPSES FOR MOVE TYPE VII
ORIGIN
DESTINATION

Figure 24

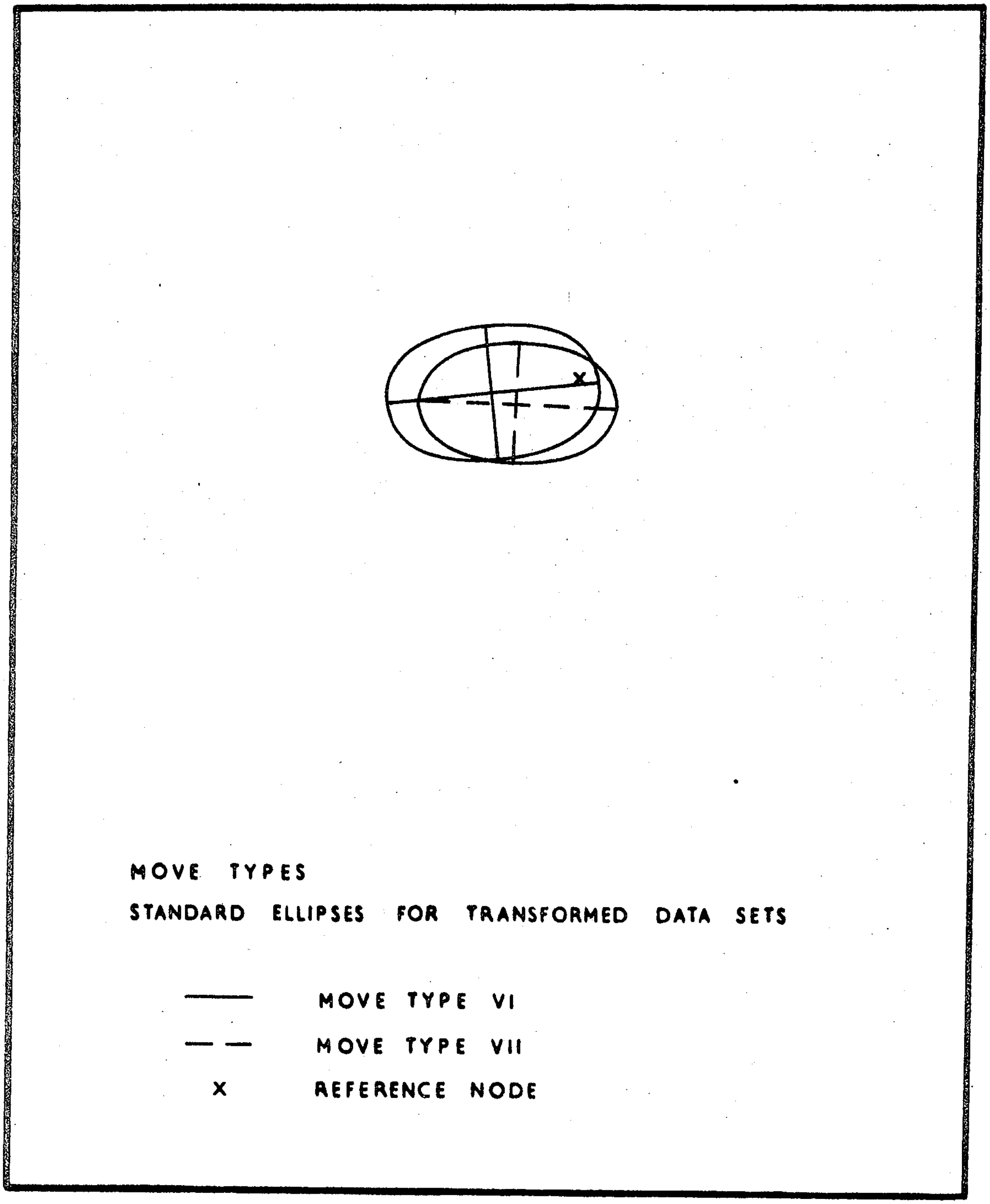

x
MOVE TYPES
STANDARD ELLIPSES FOR TRANSFORMED DATA SETS
MOVE TYPE VI
MOVE TYPE VII
X REFERENCE NODE

Figure 25

rooming houses near to the business center necessitates migrants to prefer moving towards the CBD. From the Philadelphia survey, Rossi found that the lower the economic class of a migrant, the more dependent he would be on information sources such as windfall, relatives and friends, and walking or riding around.[9] That means lower income migrants are more restricted in the employment of their awareness space in finding a vacancy. Rooming houses presumably provide dwellings for low income residents. The small coefficients of circularity exhibited show that migrants moving into rooming houses are confined within narrow sectors.

From the above account, it can be stated that distance and sectoral biases do not exist except for Move Types VI and VII, while all move types are oriented towards the CBD. The orientation towards the CBD for Move Types I, V, and VIII is contrary to the concept of the 'flight to the suburbs.' However, such an orientation for other move types conforms to the hypothesized direction. This, together with the absence of distance and sectoral bias in moves to houses and apartments, may suggest that migration patterns depends, besides on the mental map of the migrants, also on the availability of vacancies.

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[9] Rossi, op. cit. p.159-162.

CHAPTER VI

CONCLUSION

The main purpose of this study was to increase the understanding of the role of the mental map in intra-urban migration by measuring the spatial relationship of the destination with respect to the origin. The origins and destinations were analysed separately and the results were compared. The aim was to determine the effects of physical and social barriers for the areally classified data. As for the moves between and within house types, such analysis yields information about the relative location of the destinations and the origins. Based on the postulate that the initial residence is the locus from which all activities of a household originate, the data points were rotated and translated so that all destinations have one common origin. The results of analysis, as have been shown, furnish information concerning the distance, directional and sectoral bias of the migrants.

The first conclusion that can be drawn is that physical and social barriers are probably not effective in delimiting the relocation of the migrants. It can be stated that the mental map or the awareness space of a migrant does not govern the location of the new residence chosen. This inference does not substantiate the hypothesis that destinations are contained within the area of the origin.

This conclusion arises from the fact that the spread of the destinations is almost always greater than the origins, and that the displacement of the mean centers for areally classified data is towards the barriers (see Tables 1 -- 9, and Figures 3 -- 13). It has been noted that the mean centers are influenced by the most deviant points. It follows, then, that there are chances for the majority of the destinations to be contained within the area of origin. The ineffectiveness of the physical and social barriers does not mean a wholesale movement across them. Rather, it implies that the barriers cannot contain all the moves within their confines and are therefore 'permeable' in the sense that information about vacancies on the other side of the barrier can reach intended migrants on this side of the barrier.

The second conclusion is that, irrespective of the classification of the data, there is no 'flight to the suburbs' in the process of intra-urban migration. Instead, the central business district exerts a strong centripetal force on the migrants. This conclusion substantiates the hypothesis that migration is not necessarily suburban oriented. In all cases the attraction of the CBD does not mean that there is no migration towards the suburbs. Since the majority of the moves end in pre-existing dwellings, the attraction of the suburbs or the move into newly completed dwellings in the suburbs would be masked by the general trend to move towards the city center. In the cases of the moves into apartments and rooming houses, the bias towards the CBD is mainly a consequence of the areal distribution of these two dwelling types. The preference of the majority of the migrants to relocate nearer to the city center is contrary to the popular belief that migrants all tend to move to the suburbs. On the other hand, the attraction of the CBD is much weaker for migrants from the central city, even though the attraction of the suburbs cannot be established.[1]

The hypothesis that migrants are confined within narrow sectors centered on the initial dwelling cannot be applied indiscriminately. This conclusion stems from the fact that not all categories of data, whether classified areally or according to move types, display sectoral bias. Moves originating from the suburbs and ending in rooming houses display sectoral bias while the others do not exhibit any preference for locations near or on a line through the origin. Differences among the areas and the move types begin to emerge. Migrants from the suburbs are more restricted in their choice of routes to go to the CBD, so these routes form reference channels while seeking for new residences. Migrants of low socio-economic status depend heavily on windfall and walking and riding around

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[1] It is because the angles of displacement and rotation are not large enough and, most important of all, the distance of displacement is in the wrong direction. See Tables 1 -- 4.

for information about vacancies.[2] As a result, the well travelled routes will be utilized for searching suitable vacancies. For the higher socio-economic groups, the employment of newspaper and real estate agencies as sources of information[3] would enable them to view vacancies outside their route to and from the CBD.

A further conclusion is that the majority of migrants had moved over a relatively long distance and did not exhibit preference for short distance moves. Since most of the migrants moved towards the city center, a long move is possible as the area between the initial residence and the CBD is known through daily activities. The exception is the move to rooming house. A short distance move for these migrants is an outcome of the source of information used and the greater cluster of this type of dwelling.

The hypothesis that different move types would exhibit different directional, distance, and sectoral bias is verified, even though the discrepancies between the move types are not great. There is no distance and sectoral bias for Move Types I, V, and VIII, and II, IV, and IX. In spite of this, the orientation towards the CBD exhibited by Move Types II, IV, and IX conforms to the hypothesized direction, while that of Move Types I, V, and VIII does not. Further, the presence of distance, directional,

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[2] Rossi, op. cit. p.159-162.

[3] Ibid.

and sectoral bias for Move Types VI and VII distinguishes these two move types from the others. These biases arise out of the spatial distribution of the rooming houses.

The above conclusions can be summarized as follows : the employment of the awareness space or mental map in choosing a new residence varies with the area of the origin of the migrants and the type of dwelling sought. As a result, no generalized statement can be made with regard to the migration behavior. Future studies on this subject would have to incorporate the effects of the spatial distribution of dwelling types within the city and the socio-economic status of the migrants.

The following section reviews the difficulties encountered in the employment of the centrographic methods in analysing the migration data. These difficulties have been adequately discussed by Lee and Yuill.[4] The section that follows is, therefore, an elaboration of their discussion with respect to the present study.

The first difficulty is that the deviant points influence the location of the mean center and the standard deviations. This does not pose a problem for the calculation of these two statistics for the origins of the areally classified data, since all origins are contained within the area. However, if the area is large, as in the case of Area VI, the mean center and the standard deviations are

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[4] Lee, op. cit.; Yuill, op. cit.

less meaningful as measures of dispersion of the centrally located points. Yuill proposed to overcome this handicap by using the median center.[5] The criterion used to decide which to be used is the percentage of points or point-weights enclosed by the standard ellipse. The one with a larger percentage of points is chosen. One point Yuill has overlooked is that the standard ellipse calculated from the median center is not the same as that from the mean center. When the distribution is bimodal, using the median center would increase the influence of the deviant points and hence the value for the major axis. However, the minor axis would not change as much as the major axis. The coefficient of circularity would therefore decrease.[6] Furthermore, the median center can only be arrived at by a series of approximations and its location is less accurate than that of the mean center.

A small coefficient of circularity, as shown by both Lee and Yuill, may result from a bimodal distribution.[7] This is undesirable in the present study because the coefficient for the transformed data set is utilized to show the bias of the migrants to relocate on or near a line through the original residence. The smaller the

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[5] Ibid.

[6] Yuill uses "eccentricity" which varies from zero, a circle, to one, a line.

[7] Lee, op. cit.; Yuill, op. cit.

coefficient, the greater the bias would be. This conclusion may be erroneously drawn from a small coefficient resulting from a bimodal distribution. It has been noted above that the major axis may assume a greater value and therefore reduces the coefficient when the median center is used. Consequently, the median center is not regarded as a satisfactory substitute for the mean center.

Lee outlined four conditions that influence the value of the standard radius. They are : (1) relative dispersion, (2) size of the sample, (3) shape of the area, and (4) size of the area.[8] The dispersion of the data is considered to be the most important factor. However, its effect is indeed borne out by the value of the standard radius itself. If a distribution is clustered, the standard radius would be small. The reverse is true for widely scattered data. The standard radius is therefore a measure of scatter or cluster around the mean center and is an intrinsic measure.

The effect of the shape of the area on the standard radius is difficult to determine. Lee has shown that the standard radius for an even distribution within a square area would be less than that of a rectangular area of equal size.[9] The difference, however, varies with the

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[8] Lee, <u>op. cit</u>. p.60.

[9] <u>Ibid</u>., p.40.

relative length of the sides of the rectangular area. In the present study, the areas are divided according to physical and social barriers as well as political boundaries and are irregular in shape. It is therefore not possible to show any relationship between the standard radius and the shape of the area.

The value for the standard radius varies directly with the size of the area since the most deviant points in the area will have a great effect. A correlation test was conducted for the origin sets of the areally classified data and the relation is verified.[10] This finding makes the interpretation of the results more difficult if this relationship also applies to the transformed data. This is because standard radius is used for gauging distance bias. However, it is not possible to test for the relationship for the transformed data since the destination can end anywhere within the study area. The same applies to the move type data sets.

The standard radius is postulated to bear a direct relationship with the size of the sample. A correlation test revealed that this does not apply to all the data sets in the present study. A direct relationship exists for the three data sets classified according to dwelling

---

[10] See Appendix 3

types. On the other hand, an inverse relationship was found for the areally classified data, though the correlation coefficient was not statistically significant.[11] This finding poses problems in the interpretation of the standard radius as a measure of distance bias for smaples of unequal size.

The effects of the shape and size of the area and the size of the sample cannot be easily eliminated or held constant in studies of intra-urban migration. This is because study areas, or urbanized area, are never regular in shape. This is further accentuated if the urban area is subdivided into areas of differing socio-economic status. It is also very difficult to subdivide these areas into equal sizes. However, attempts can still be made to minimize the differences in shape and size among sub-areas. In contrast, the size of the sample cannot be controlled, because the number of households undertaking a move varies with time and with sub-areas within an urban area.[12] In view of all the uncontrollable influences care must be taken while interpreting the results, especially if the centrographic measures are used to obtain them.

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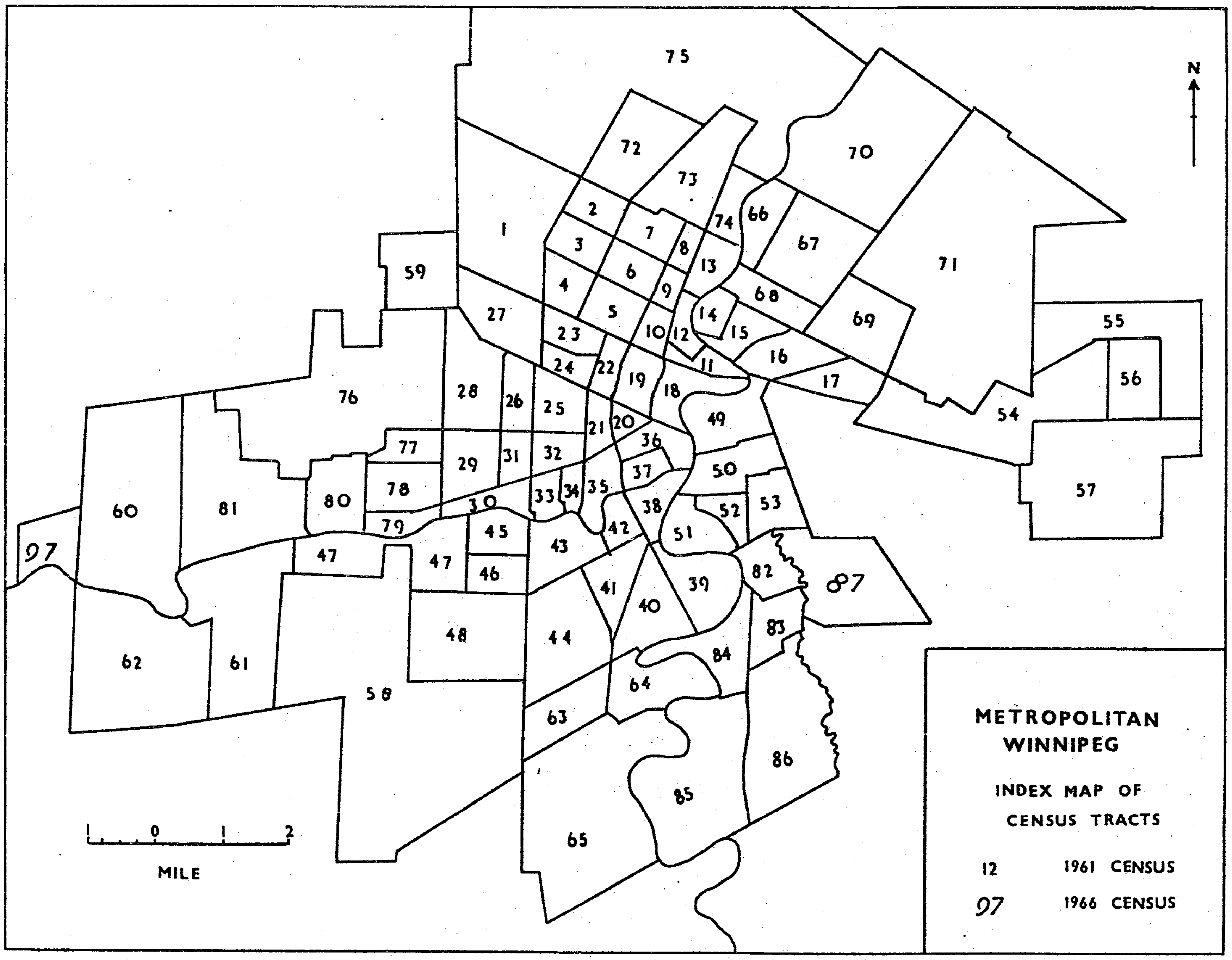
[11] See Appendix 3.

[12] Freedman, op. cit.


N
METROPOLITAN
WINNIPEG
INDEX MAP OF
CENSUS TRACTS
12 1961 CENSUS
97 1966 CENSUS
0 1 2
MILE

Appendix 1

Appendix 2

THE CØMPUTER PRØGRAM USED TØ ANALYSE THE DATA :

```
C  THIS IS A PRØGRAM FØR CENTRØGRAPHIC MEASURES
C  SUBRØUTINE TRANRØ  PERFØRMS THE RØTATIØN AND TRANSLATIØN
C  ØF THE AXES
C  SUBRØUTINE STAT CALCULATES THE MEASURES USED
C  SUBRØUTINE ELLIP CALCULATES THE PØINTS FØR PLØTTING THE
C  STANDARD ELLIPSE
C  INPUTS ARE THE LOCATIØNS ØF THE DESTINATIØN AND ØRIGIN
C  OF EVERY MOVE
C
      DIMENSIØN CX(420),CZ(420),X(420),Y(420),A(40),B(40)
     1,D(40), CY(420)
      CØMPLEX CX, CY, CX
      CØMMØN CX,CY,CZ,X,Y
      DØ 100 I=1,1000
      READ (5,1) CY(I),CX(I),IEND
    1 FØRMAT(4F4.0,I2)
      IF (IEND.GT.0) GØ TØ 101
  100 CØNTINUE
  101 N=I
C  MØDE =-2 CALCULATE STATISTICS FØR DESTINATIØNS
      CALL TRANRØ (N,-2)
      CALL STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,0)
      CALL ELLIP (A,B,C,D,40,BARX,BARY,SDX,SDY,ANGLE)
C  MØDE=-3 CALCULATE STATISTICS FØR ØRIGINS
      CALL TRANRØ (N,-3)
      CALL STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,0)
      CALL ELLIP (A,B,C,D,40,BARX,BARY,SDX,SDY,ANGLE)
C  MØDE=-1 ROTATE,MØDE=0 TRANSLATE,MØDE=1 RØTATE AND
C  TRANSLATE
C  NØUT=2 WRITE DATA ØUT
      CALL TRANRØ (N,-1)
      CALL STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,0)
```

```
      CALL TRANRØ (N,0)
      CALL STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,0)
      CALL TRANRØ (N,1)
      CALL STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,0)
      CALL ELLIP (A,B,C,D,40,BARX,BARY,SDX,SDY,ANGLE)
      STØP
      END

      SUBRØUTINE TRANRØ (N,MØDE)
      DIMENSIØN X(420),Y(420),Z(420),RX(420),RY(420)
      CØMPLEX CMPLX,BETA,CEXP,X,Y,Z
      CØMMØN X,Y,Z,RX,RY
      IF (MØDE.EQ.-2) GØ TØ 401
      IF (MØDE.EQ.-3) GØ TØ 501
      IF (MØDE)1,201,1
    1 DØ 100 I=1,N
      RAX=REAL(X(I))
      RAY=AIMAG(X(I))
      IF(RAX.NE.0) GØ TØ 10
      Z(I)=Y(I)*CMPLX(0.0,-1)
   10 A1=ATAN2(RAY,RAX)
      BETA=CMPLX(0.,-A1)
      Z(I)=Y(I)*CEXP(BETA)
      RX(I)=REAL(Z(I))
      RY(I)=AIMAG(Z(I))
  100 CØNTINUE
      IF(MØDE.EQ.1) GØ TØ 301
      RETURN
  201 DØ 200 I=1,N
      Z(I)=Y(I)-X(I)
      RX(I)=REAL(Z(I))
      RY(I)=AIMAG(Z(I))
  200 CØNTINUE
      RETURN
```

```
301 DØ 300 I=1,N
    RX(I)=REAL(Z(I)-CABS(X(I)))
    RY(I)=AIMAG(Z(I))
300 CØNTINUE
    RETURN
401 DØ 400 I=1,N
    RX(I)=REAL(Y(I))
400 RY(I)=AIMAG(Y(I))
    RETURN
501 DØ 500 I=1,N
    RX(I)=REAL(X(I))
500 RY(I)=AIMAG(X(I))
    RETURN
    END

    SUBRØUTINE STAT (N,BARX,BARY,SDX,SDY,RXY,R,ANGLE,NØUT)
    CØMPLEX CX,CY,CZ
    CØMMØN CX,CY,CZ,X,Y
    DIMENSIØN X(420),Y(420),CX(420),CY(420),CZ(420)
  1 FØRMAT (20F6.1)
  2 FØRMAT ('0','MEAN(',2F7.3,') SDX(',F7.3,') SDY(',F7.3,')
   1CØVARIANCE(',F7.3,') STANDARD RADIUS(',F7.3,') ANGLE
   2(',F7.3,') R(',F7.3,')')
  3 FØRMAT ('0','CØEF',F7.3)
  4 FØRMAT ('0','DISTANCE OF DISPLACEMENT(',F7.3,') ANGLE
   1ØF DISPLACEMENT(',F10.3,')')
    BARX=BARZ(X,N)
    BARY=BARZ(Y,N)
    RXX=RHØZ(X,X,N,BARX,BARX)
    RYY=RHØZ(Y,Y,N,BARY,BARY)
    RXY=RHOZ(X,Y,N,BARX,BARY)
    SD=SQRT(RXX+RYY)
    R=RXY/SQRT(RXX*RYY)
    SDX=SQRT(RXX)
    SDY=SQRT(RYY)
```

```
      ANGLE=ALPHA(R,SDX,SDY,RXY)*57.2958
      CØEF=AMIN1(SDX,SDY)/AMAX1(SDX,SDY)
      WRITE (6,3) CØEF
      DØD=SQRT(BARX**2+BARY**2)
      AØD=ATAN2(BARY,BARX)*57.2958
      WRITE (6,4) DØD,AØD
      IF(NØUT.EQ.2) WRITE (6,1)(X(I),Y(I),I=1,N)
      WRITE (6,2) BARX,BARY,SDX,SDY,RXY,SD,R,ANGLE
      RETURN
      END

      SUBRØUTINE ELLIP (X,Y,C,D,M,XØ,YØ,SDX,SDY,ANGLE)
      DIMENSIØN X(M),Y(M),C(M),D(M)
      MH=M/2
      GAMMA=ANGLE/57.2958
      CØSA=CØS(GAMMA)
      SINA=SIN(GAMMA)
      DC=2.*SDX/MH
      DØ 100 I=1,MH
      C(I)=-SDX+DC*I
      IF (C(I).EQ.0.) GØ TØ 400
      D(I)=SDY*SQRT(1.-C(I)*C(I)/(SDX*SDX))
      GØ TØ 100
  400 D(I)=SDY
  100 CØNTINUE
      DØ 200 I=1,MH
      J=I+MH
      C(J)=-C(I)
  200 D(J)=-D(I)
      DØ 300 I=1,MH
      X(I)=C(I)*CØSA+D(I)*SINA
      Y(I)=D(I)*COSA-C(I)*SINA
      X(I)=X(I)+XØ
  300 Y(I)=Y(I)+YØ
      WRITE (6,1)(X(I),Y(I),I=1,M)
```

```
 1 FØRMAT (20F6.1)
   RETURN
   END

   FUNCTIØN BARZ(Z,N)
   DIMENSIØN Z(N)
   BARZ=0.
   DØ 10 I=1,N
10 BARZ=BARZ+Z(I)
   BARZ=BARZ/FLØAT(N)
   RETURN
   END

   FUNCTIØN RHØZ (Z1,Z2,N,BARZ1,BARZ2)
   DIMENSIØN Z1(N),Z2(N)
   RHØZ=0.
   DØ 10 I=1,N
10 RHØZ=RHØZ+(Z1(I)-BARZ1)*(Z2(I)-BARZ2)
   RHØZ=RHØZ/FLØAT(N)
   RETURN
   END

   FUNCTIØN ALPHA (R,SDX,SDY,RXY)
   IF (ABS(SDX*SDX-SDY*SDY).LT.1.E-5) GØ TØ 10
   TAN=2.*R*SDX*SDY/(SDX*SDX-SDY*SDY)
   ALPHA=0.5*ATAN(TAN)
   RETURN
10 ALPHA=0.7854
   RETURN
   END
```

Appendix 3

A. Correlation coefficient between size of area and the value of the standard radius of the origin set of areally classified data :

0.60*

B. Correlation coefficients between sample size and the value of the standard radius of areally classified data sets

Data Set	Correlation Coefficient
Origin	-0.331*
Destination	-0.473*
Rotated and Translated	-0.550*

C. Correlation coefficients between sample size and the value of the standard radius of move type data sets

Data Set	Correlation Coefficient
Origin	0.653*
Destination	0.839
Rotated and Translated	0.818

* Not statistically significant at 0.99 level.

Appendix 3 (Cont'd)

D. Correlation coefficient between mobility rate[1] and the total number of dwelling units completed.[2] from January 1964 to December 1969 :

0.126*

E. A regression analysis is applied to the number of apartments taken up and the total number of apartments completed during the period January 1964 to August 1969[3] :

$$Y = 82.7 + 0.473\ X$$

Correlation Coefficient : 0.687**

Even though the number of apartments taken up varies significantly with the number of apartments completed, the regression formula indicates that for every one hundred apartments completed, only fourty-seven will be taken up.

---

* Not statistically significant at the 0.99 level.

** Statistically significant at the 0.99 level.

[1] The mobility rate was calculated by the writer from the monthly report of the MTS which contains information about the total number of connection and disconnection of telephones in private residences.

[2] The total number of dwelling units completed was obtained from raw data kept at the Central Mortgage and Housing Corporation, Prairie Regional Office, Winnipeg.

[3] For the data source, see Footnote 2.

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