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The evolution of public transport networks in Windsor, (Ontario), London, (Ontario), 1872--1968.

Robert Markovich
University of Windsor

THE EVOLUTION OF PUBLIC TRANSPORT NETWORKS IN WINDSOR, (ONTARIO), AND LONDON, (ONTARIO), 1872 - 1968

BY

ROBERT MARKOVICH

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Approved by

Anthony Blackbourn

Jack C. Ransome

Ihor Stebelsky

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ABSTRACT

The size and shape of public transportation networks in Windsor, (Ontario), and London, (Ontario), between 1872 and 1968 may be realted to changes in technology and to city growth. The networks remained stable for many years despite population growth, until technological advances permitted a change in the mode of public transportation. This, in turn, affected the size and shape of the cities' public transportation networks.

Examination of this problem required analysis of network evolution in both cities to determine the degree to whcih network development was affected by new modes of transportation. This process was simplified by the use of a series of maps developed for several corresponding time periods in each city. Objectivity of analysis was achieved by employing simple indices taken from graph theory as measures of topological change.

Investigation established that public transportation networks in Windsor and London maintained a similarity of development in spite of differences in history, topography, urban morphology and socio-economic characteristics. Network change was closely associated with advances in technology, although political influences such as annexations, were also important in recent network expansions. At the

same time, it was discovered that the application of the König Number to a particular network showed a close relationship between change in location of the most central node in the network and the movement of the Central Business District.

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CHAPTER I

INTRODUCTION

This paper compares the evolution of public transportation networks in Windsor, (Ontario), and London, (Ontario), between 1872 and 1968. The paper will show that the changes in technology permitted expansion of the networks, altering their size and shape. Ability to determine the extent of change in size and shape would determine subsequent effects on the quality of service[1] offered to the public.

In addition, the paper will show that it was the advances in technology, rather than population growth, that were primarily responsible for network change in Windsor and London.

Finally, an attempt will be made to discover if public transport networks may be used to study changes in centrality within cities.

Reasons for Choosing Windsor and London

Windsor and London were chosen for the study because they are similar in size. At the same time, their networks are simple enough to permit analysis, yet complex enough to be interesting. As both cities are known to the author, changes in their networks could be interpreted readily. Finally, both cities have produced networks which have been in existance for nearly one hundred years and, therefore, lend themselves well to historical inquiry.

During the early stages of research several other cities were considered such as Kingston, Sault Ste. Marie, Kitchener-Waterloo, Hamilton, Toronto and Ottawa. Kingston and Sault Ste. Marie were not investigated because they were too small and their transit systems were poorly developed.

In the Kitchener-Waterloo area, there was almost no change in the public transportation system between 1900 and 1930. The only public transportation was an electric line operating along the main street between Kitchener and Waterloo. Although buses have been introduced since 1930, they are serving as 'feeders' during rush hours for the main line[2]. Consequently, bus schedules are too infrequent to warrant consideration.

Toronto, on the other hand, was far too large and complex. Hamilton was considered, but the lack of historical data prevented its use. Ottawa could have been used, but it too, is larger than Windsor and London. At the same time it is too far away to be practical for this type of research were frequent visits were necessary.

<u>Research and Selection of Data</u>

Most of the information used in this study came from primary sources such as Sandwich, Windsor and Amherstburg Railway Company, (S.W. & A.), and The London Transportation Commission, (L.T.C.). Data was also obtained from interviews, newspaper clippings, historical books and old maps.[3] The major concern was to collect enough information to enable drafting of a series of route maps which would represent the public transportation networks in each city between 1872 and 1968. The original intent was to develop maps for every ten year period, beginning with 1891. These maps were to coincide with the Census of Canada publications -- 1891, 1901, 1911, 1921 and so on, but past records were sketchy and often had to be pieced together. Consequently, it was necessary to settle for whatever information was available, (see (Table 1).

Table 1

A LIST OF DATES FOR WHICH MAPS WERE COMPILED

Windsor	London
1893	1893
--	1897
--	1909
1917	
1930	1920 to 1937
1937	
--	1945
1950	1950
1968	1968

Unfortunately, public transportation companies do not keep records of route changes for more than a few years after the route changes become obsolete. The existence of older records is usually accidental. Despite this, both companies, S.W. & A. and the L.T.C. were willing to help. In some cases interviews with drivers who still remembered where streetcar lines had been, were necessary.

In order that the material be collected, several trips to London were necessary. Public libraries in both cities, particularly the London Room at the London Public Library, were extremely helpful in supplying historical facts from old maps and newspaper clippings. The Hiram Walker Historical Museum in Windsor, was another excellent source of information. Current, as well as older maps were obtained from the urban planning departments in Windsor and London. However, these departments could produce only a limited amount of historical information. Even data as recent as 1950 was seldom on record -- probably due to a general lack of storage space.

Many books and publications dealing with the evolution of public transportation in Canada and United States were also of great value[4]. These sources rendered a general understanding of trends and related elements governing the development of mass transportation during the past one hundred years. These sources outlined the problems faced by many cities in the past, as well as the present, in coping with the seemingly impossible task of moving urban masses to and from their destinations.

General Problems Faced by Mass Transit Systems

As the physical size and population of cities became larger, the problem of providing public transportation within urban areas became increasingly acute. Growing population, greater distances and the importance of time remained ahead of what technology could produce to meet expanding demands on public transportation. While all cities were not alike in design or topography, they all had similar technological means at their disposal during various stages of their development.

Before the discovery of the electric traction motor in 1884[5] and the overhead trolley in 1887[6], animal power provided the best form of public transportation. Steam power was available, but considered too noisy and too dirty for city use. Throughout history, animals had been used in one way or another, but the major breakthrough occured around the middle of the nineteenth century when horse-drawn cars were placed on rails. This development permitted a single horse to pull a large car, seating twenty persons or more, over smooth metal rails with relatively little effort.

As technology continued to advance, newer and better methods of transporting the public were devised. At first electric streetcars, and later gasoline and diesel-powered buses were developed. During this period the increasing use and popularity of the private automobile reduced patronage, and therefore profits of public transit companies were also reduced. It appears, therefore, that neither the streetcars nor the buses have adequately solved the problem of moving large numbers of people quickly and economically.

For a network to provide good service, it should offer the public a rapid, frequent and reasonably inexpensive means of transportation to all parts of the city. This may be accomplished by supplying a fast, dependable carrier, and by constructing a greater density of lines so that all areas of the city are interconnected. In short, one may state that service improves as connectivity becomes greater.

Organization of Material

Although larger cities such as Toronto, New York and London, (England), had dveloped mass transit systems as early as the middle of the nineteenth century, smaller cities such as Windsor, (Ontario), and London, (Ontario), had little need for public transportation until the 1970's because they were too small. Thus a period of nearly one hundred years, from 1872 to 1968, appears to be relevant for analysis. However, an attempt to deal with this entire time span would be cumbersome and impractical. Therefore, it was decided that public transportation during the last one hundred years could best be studied if divided into two major stages of growth.

Change in technology was the criterion used for this division. The first stage discussed in Chapter II, deals with rail transportation from 1872 to 1945. The second stage, covered by Chapter III, is concerned with buses from 1945 to 1968. In addition, each of these segments was further subdivided into units (A) and (B). In Stage 1, technology was, again, the criterion applied for the subdivision. Thus, Stage 1, (A) and (B), treat horse-drawn and electric rail transportation respectively.

In Stage 2, however, criteria for subdivision was not based on technology, but on the changes in route patterns resulting from annexation. Consequently, (A) deals with bus routes for 1950, and (B) analyzes bus networks in 1968.

As corresponding base maps could not be obtained for each time period listed in Table 1, recent maps of Windsor and London were used as a base for network outlines. Therefore, these maps represent only the network patters under the dates outlined, not the actual size and shape of the urban areas. Each of these maps was redrawn in a stylized form to permit the application of measuring indices.

Measuring Indices and Reasons for Choice of Indices

Although this paper is basically historical in nature, and could have been completed using a descriptive approach, it was felt that a simple, objective measure of topological change was necessary. Therefore, the following indices have been chosen: the Beta Index[7], 'weighted networks'[8] and the König Number[9].

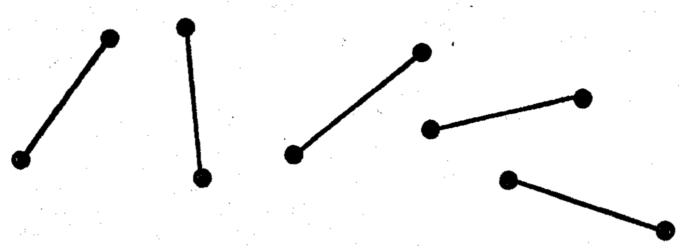
The Beta Index -- is defined as B = e/v, where 'e' is the number of edges and 'v' is the number of vertices or nodes[10]. The Beta Index has the capacity to measure connectivity and may be used, therefore, to determine whether or not service is improving.

The Beta Index has a range of values from 0 to 3 in

Fig. 1

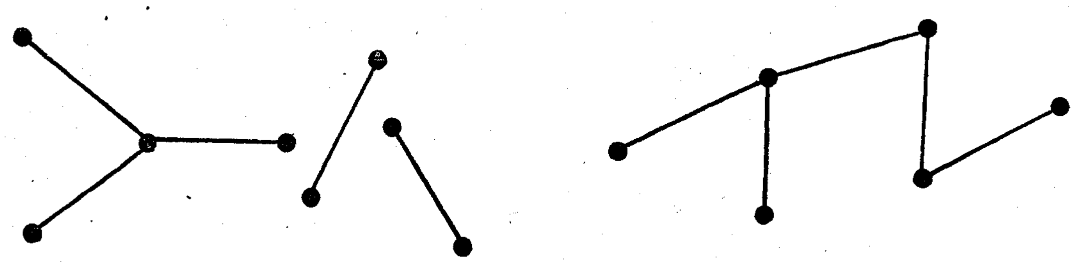
KANSKY'S USE OF THE BETA INDEX

(A) Disconnected Networks



B = .50

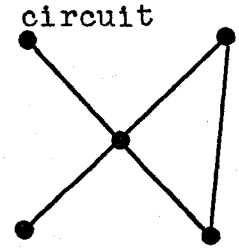
(B) Trees; simple networks without circuits



B = .62

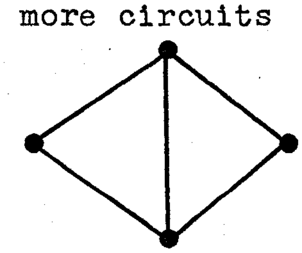
B = .83

(C) Networks with one circuit



B = 1.00

(D) Networks with two or more circuits



B = 1.25

planar applications, and may, in addition, be used to discover whether a network is a 'high-cost-to-use' or a 'least-cost'to-use'[11], and how quickly it is progressing toward the latter condition. As higher connectivity implies better service, and as better service reduces the cost of using the network, higher values of Beta, therefore, indicate that a network is progressing toward a 'least-cost-to-use' condition: the reverse is also true.

Weighting of Networks -- The size and the carrying capacity of a network, as well as its connectivity may be established through the sum weight of its vertices.[12]. In a weighted network the endpoints of individual routes are considered to have a value of 1, as only one line or ray is entering the node. Third order, and higher order vertices are weighted by 2, for each ray converging upon the intersection. Thus, a T-junction would have a weighted value of '6'. The higher the sum total of a network, the more developed it should be. Higher values indicate a larger proportion of higher order intersections which have the ability to handle larger volumes of traffic.

> "It is assumed that networks with a large number of high order vertices are capable of handling larger amounts of traffic flow than networks with a small number of high order vertices, because the high order vertices perform a relatively larger number of functions than the low order intersections."[13]

It must be pointed out that the above quotation could imply congestion if the automobile were brought into the picture.

This being the case, the private automobile could create congestion even along a single line, away from any intersections.

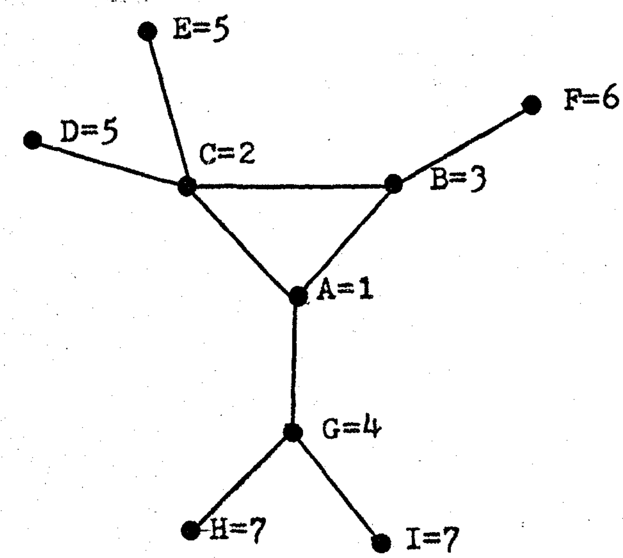
<u>The König or Associated Number</u> -- When this index was applied to a transportation network over several consecutive time periods, it had the ability to measure changes in centrality within a network, and will be used for this purpose.

The König Number provides, "an understanding of the maximum number of edges from a given vertex to each of the other vertices".[14] This means that one must count the maximum number of edges between two chosen vertices or intersections. Forest R. Pitts, however, uses the minimum number of edges rather than the maximum to arrive at a measure of network centrality.[15] (Pitts' method is demonstrated in Fig. 2).

Applying the 'minimum number of edges' approach used by Pitts, (Fig. 2), one may obtain a value of '0' from A to A; a value of '1' from A to B; '1' from A to C; '2' from A to D, and so on. These values are entered in a matrix from left to right until the matrix has been filled. Each row is then added and the sums placed under the 'Total'. At this point each vertex will have a value. If these values are ranked according to size of number, A = 1 emerges as the most central, while H = 7 and I = 7 become the least central.

Fig. 2

PITT'S USE OF THE KÖNIG NUMBER



	A	B	C	D	E	F	G	H	I	TOTAL	RANK
A	0	1	1	2	2	2	1	2	2	13	1
B	1	0	1	2	2	1	2	3	3	15	3
C	1	1	0	1	1	2	2	3	3	14	2
D	2	2	1	0	2	3	3	4	4	21	5
E	2	2	1	2	0	3	3	4	4	21	5
F	2	1	2	3	3	0	3	4	4	22	6
G	1	2	2	3	3	3	0	1	1	16	4
H	2	3	3	4	4	4	1	0	2	23	7
I	2	3	3	4	4	4	1	2	0	23	7

Pitts' method appears to be limited without the use of some flow data as a corrective measure. When dealing with the past such information is usually difficult, if not impossible to obtain. However, as flow data was available in Windsor for 1968, an attempt was made to discover if Pitts' method can be improved by including flow data as a corrective factor.

Limitations of the Measuring Indices

The analytical techniques discussed in this chapter, together with outhers found in K. J. Kansky's, Structure of Transportation Networks: Relationships between Network Geometry and Regional Characteristics, [16] represent the basic tools used to evaluate change in this paper. They are useful because they are simple to apply and to interpret. However, because of this simplicity they do not always reveal a complete picture. For example, connectivity was seen to drop slightly between 1950 and 1968 in Windsor, yet during the same time the network mileage increased considerably. In other cases these indices provide measures for things which are often self evident. For instance, it is quite obvious that an intersection with four rays can handle more traffic than an intersection with only three rays. However, the sum of these weighted intersections provides a suitable method for comparison of network growth through time.

The Associated or König Number, also found in Kansky is likewise limited to simple applications. A study of highway systems in northern Ontario by Ian Burton,[17] for example, employs the Associated Number to indicate which links are more important and where additional links are needed. However, it fails to reveal in any concrete way just exactly how important one connective is in relation to another. It is quite possible for a connective to appear as more important with a higher associated number, simply because there is an absence of vertices along its length, although in reality it may be a long, out-of-the-way detour.

In order that these measurements might become more meaningful, corrective data would again be required. Distance in miles, or road quality provide two examples of corrective factors. A corrective factor would be particularly important in network analysis where a longer route is known to be a faster one, due to the absence of traffic lights. In examination of streetcar networks, the knowledge whether a single or double track existed along a particular street would also be important. In both cases, historical data on traffic lights, as well as streetcar tracks is limited.

Despite shortcomings of graph theory, some useful insite for this study was obtained from a number of sources dealing with graph theory[18]. Additional material used to complete this paper was of a more practical, rather than theoretical nature. This material was primarily composed of urban studies conducted in Windsor and London[19] and provided vital information about the morphology of each city.

CHAPTER I

NOTES

1. The term 'service' when used in this paper will refer only the convayance of passengers by streetcars and buses. Service improves as scheduling becomes more frequent and the density of lines in a city becomes greater, reducing waiting time and the walking distance to car or bus stop.

2. Interview with Mr. N. Reitzel, operating superintendent, Public Utilities Commission of Kitchener, 1968.

3. A great deal of background information was obtained from sources of historical nature such as Niel F. Morrison, Garden Gateway to Canada. Toronto: The Ryerson Press, 1954. Similar examples from which a record of dates and events was compiled are, Fredrick Neal, Township of Sandwich, Windsor: The Record Printing Company, Limited, 1909., and The Essex County Historical Association, The Essex County Radio Sketches, Windsor.

4. Publications dealing with the evolution of public transportation in Canada and United States were of particular value in rendering a general understanding of trends and related elements governing the development of public transportation. G. Glazebrook, A History of Transportation in Canada. Toronto: The Ryerson Press, 1938., and Mildred M. Walmsley, "The Bygone Electric Inter-Urban Systems", The Professional Geographer. (1965), pp. 1-5., provide two good examples of this type.

5. Mildred M. Walmsley, "The Bygone Inter-Urban Systems", The Professional Geographer. (1965), p 1.

6. Ibid., p. 1

7. K. J. Kansky, Structure of Transportation Networks: Relationships Between Network Geometry and Regional Caracteristics. (Chicago, 1963), p. 28.

8. Ibid., p. 26.

9. Forest R. Pitts, "Graph Theoretic Approach to Historical Geography", The Professional Geographer. (1965), pp. 15-20.

10. K. J. Kansky, Structure of Transportation Networks: Relationships Between Network Geometry and Regional Characteristics. (Chicago, 1963), p. 28.

11. *Ibid.*, p. 28.

12. Ibid., p. 26.

13. Ibid., p. 26.

14. Forest R. Pitts, "Graph Theoretic Approach to Historical Geography", *The Professional Geographer*. (1965), p. 16.

15. *Ibid.*, p. 16.

16. K. J. Kansky, *Structure of Transportation Networks: Relationships Between Network Geometry and Regional Characteristics*. (Chicago, 1963).

17. Ian Burton, *Accessibility in Northern Ontario: An Application of Graph Theory to a Regional Highway Network*. (1962), pp. 1-25.

18. William L. Garrison, "Connectivity of the Interstate Highway System", *Papers and Proceedings*. (1960), pp 122-137., may be considered as one of the more important studies of transportation networks where graph theory has been used.

19. Traffic studies in Windsor and London were particularly important to this study because they offered data regarding automobile traffic flows which was very useful as a comparison against bus networks. Two examples of this nature are, Faludi, E. G. *Windsor's Master Plan, 1945 - 1975*. Toronto: 1945., and Margison, A.D. and Associates, *London Area Traffic Plan, 1959 - 1980*. London: 1960.

CHAPTER II

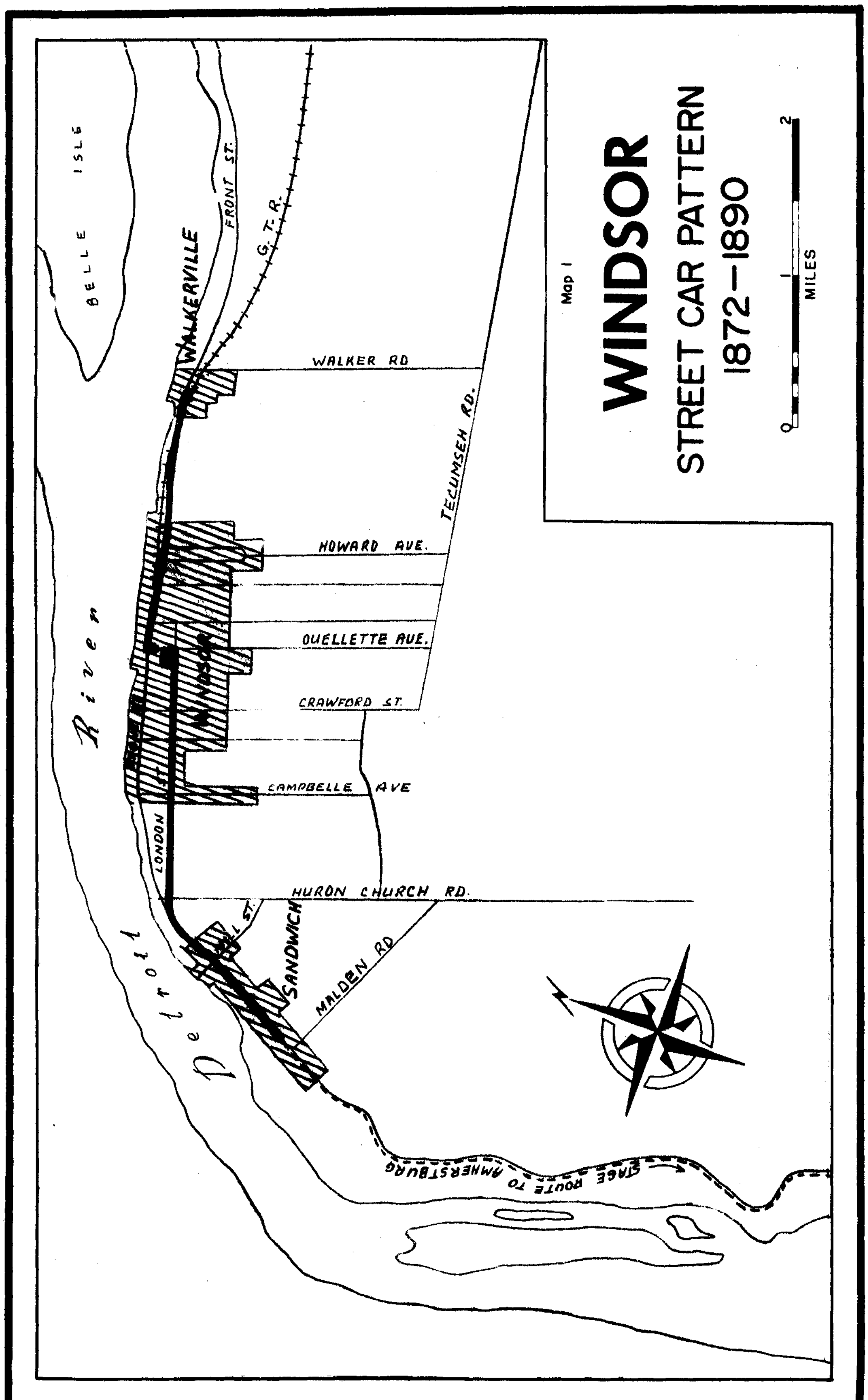
STAGE 1 -- RAIL TRANSPORTATION

(A) -- Horse-Drawn Streetcars

Windsor

Public transportation in Windsor and London began during 1872 in Windsor and 1875 in London in the form of horse-drawn streetcars.[1] The process was similar in both cities, though not identical. Windsor, during the 1870's was smaller than London and therefore had less need for public transportation, see Table 2. The area which makes up the city of Windsor today developed from several small communities clustered along the Detroit River, separated by fields and farmland, Map I. Windsor, located in the center, was the largest, while Sandwich, three miles to the west and Walkerville, two miles to the east, were considerably smaller. In 1904 the opening of Ford Motor Company of Canada,[2] situated one mile east of Walkervile, encouraged the appearance of a fourth town which became known as 'Ford City' or East Windsor, populated primarily by Ford workers.

The nucleated settlement along the river meant that each town grew independently of the other, too small therefore, to feel the need for public transportation within its own town limits, (Map I). Nevertheless, a great deal of interaction existed among them, especially between


Map 1
WINDSOR
STREET CAR PATTERN
1872–1890
0
1
2
MILES
BELLE ISLE
Detroit River
WALKERVILLE
FRONT ST.
G.T.R.
WALKER RD
TECUMSEH RD.
HOWARD AVE.
OUELLETTE AVE.
CRAWFORD ST.
CAMPBELLE AVE
WINDSOR
LONDON
HURON CHURCH RD.
SANDWICH
MALDEN RD
STAGE ROUTE TO AMHERSTBURG

Sandwich and Windsor. By 1870 the latter had become the largest settlement on the Canadian side of the Detroit River, even though Sandwich remained as the administrative center.[3] In addition, Sandwich was an important resort town, visted by many Windsorites and Detroiters during the summer months.[4] Together, these two factors encouraged a great deal of travel between the two communities.

Travelling by stage or buggy over the rough roads, often impassible during bad weather, was a constant burden that prompted the formation of the Windsor-Sandwich Street Railway Company in 1872. Other interests in 1886 also formed the Windsor-Walkerville Street Railway Company.[5] Both lines provided a primarily inter-urban service for the three communities, (see (Map I). As the two lines provided service between Windsor and Walkerville and between Windsor and Sandwich, they had little direct effect within the three towns. However, the lines had some effect upon population growth outside of their city limits, as people purchased property on either side of the right-of-ways, particularly where cars stopped to pick up or discharge passengers.[6] Norman D. Wilson explained that this was very common in many cities during the 1800's.[7] The increased speed and carrying capacity of the horse-trams appreciably widened the commuting radius and thus encouraged outward expansion of towns and cities.[8] This trend eventually resulted in a complete merger of Sandwich, Walkerville and East Windsor with the city of Windsor in 1935.[9]

London

During the early period of London's development between 1870 and 1890, population growth was very rapid,[10]. By 1898 London had already extended its city limits to include London East, London South and London West.[11] The area remained nearly the same until 1966, (Table 2). Thus as a single, compact unit, and as a center of a larger population than Windsor, London had a greater need for intraurban public transportation.

In 1875 horse-trams had made their appearance along main streets within the downtown[12], (Map II). The first lines to be opened were along Richmond and Dundas Streets. The Dundas line connected the central portion of the city with an important industrial complex around Egerton in the east, while the Richmond line was built to serve the C.P.R. station and residents in the north, (Map II). Later the Pall Mall line appeared as a branch east from Richmond, past the C.P.R. station to the infantry barracks. In time, additional lines were added to serve other nodes within the city.

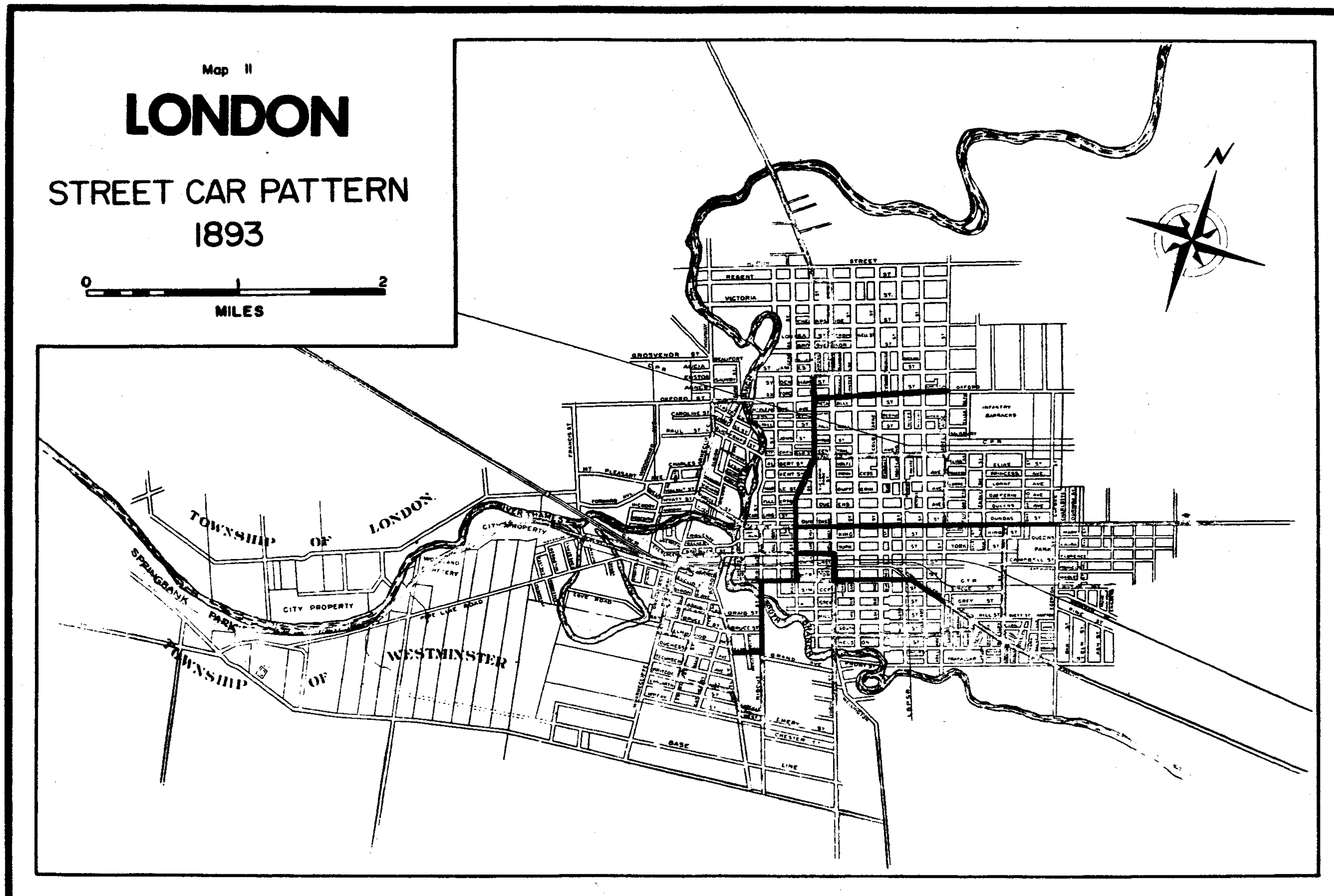
During this early stage of development, connectivity, was very poor. The networks in both cities were very simple, maintaining the characteristic 'disconnected'[13] and 'tree'[14] patterns discussed by Kansky. These patterns are common among networks during their early stage of development and support Beta Index values of less than 1.00,[15] (see (Table 3).

Table 2

CHANGES IN AREA AND POPULATION OF WINDSOR AND LONDON
1891 - 1966

Year	Windsor		London	
	Pop.	Area	Pop.	Area
1891	10,322	--	22,281	--
1901	12,153	8,240	37,976	6,873
1911	17,829	"	46,300	"
1921	38,591	"	60,959	"
1931	63,108	"	71,148	"
1941	105,311	8,250	78,134	"
1951	120,672	"	128,977	7,915
1966	192,544	31,583	181,283	42,550

a - The figures which have been included under Windsor, represent the area of the Border Cities between the years 1891 and 2951. However, the population figures are for Windsor, alone.


Map II
LONDON
STREET CAR PATTERN
1893
0 1 2
MILES
TOWNSHIP OF LONDON
TOWNSHIP OF WESTMINSTER
CITY PROPERTY
SPRINGBANK PARK
INFANTRY BARRACKS
N

London with a Beta value of .83 had progressed from a simple 'disconnected' shape, still apparent in Windsor, to a slightly more complex 'tree' network by developing a larger number of branches. Whereas, in Windsor the two lines were 'disconnected' and spread out between Sandwich, Windsor and Walkerville; in London the entire expansion took place entirely within the city limits, (compare Maps I and II). As both networks exhibited low values of Beta during this stage they must be considered as 'high-cost-to-use', although they were adequate for the small towns which they served.

Lack of development within the two networks, particularly in Windsor, is demonstrated by the low 'network weight', (see Table 4). In 1890 London's 'network weight' was 21 as a result of two higher order intersections having been developed in the downtown. In Windsor there were no such intersections at all. Consequently, its 'network weight' was only 4 and its capacity to carry higher volumes of traffic was severely limited, although the total mileage of both networks was almost equal, (see Table 4).

In theory, both networks, based on the Beta Index, possessed a low level of connectivity, although in London connectivity was much better than in Windsor, as the more radial pattern permitted access in several separate directions, whereas, in Windsor predominantly linear pattern of the network permitted movement only east and west.

Table 3

BETA INDEX VALUES, 1872 - 1968

Year	Windsor	London
1872	.50	--
1893	.77 and 1.00[a]	.87
1897	--	1.16
1909	--	1.24
1917	1.14	1.24
1920	--	1.24
1930	1.33	1.24
1937	1.05	1.24
1950	1.48	1.31
1968	1.47	1.33

a - The value of .77 under Windsor, applies for the early part of 1893. Near the end of 1893 a new line was added, changing the value to 1.00

Table 4

TOTAL WEIGHT OF NETWORKS AND TOTAL ROUTE MILEAGE 1872 - 1968

Year	Windsor		London	
	Weight	Mileage	Weight	Mileage
1872	4	5	--	--
1893	9 and 21[a]	8	23	6
1897	--	-	81	19
1909	--	-	117	21
1917	56	22	124	23
1920	--	--	124	23
1930	111	34	124	23
1937	71	32	124	23
1950	240	64	236	40
1968	289	95	295	95

a - The 'weight' value of 9 under Windsor, applies for the early part of 1893. Near the end of 1893 a new line was added, changing the value to 21.

(B) Electric Streetcars

Development of the electric railway motor during the 1880's enabled Windsor as well as London to adopt electric transportation by the end of 1895. Greater speed, dependability and operating radius insured by electric power made is possible for both cities to expand their original tram lines in all directions. The opening of additional lines improved connectivity in both systems by allowing passengers to reach their desired destination quickly and more directly. At the same time new areas were made accessible as they became connected with the center of the city.

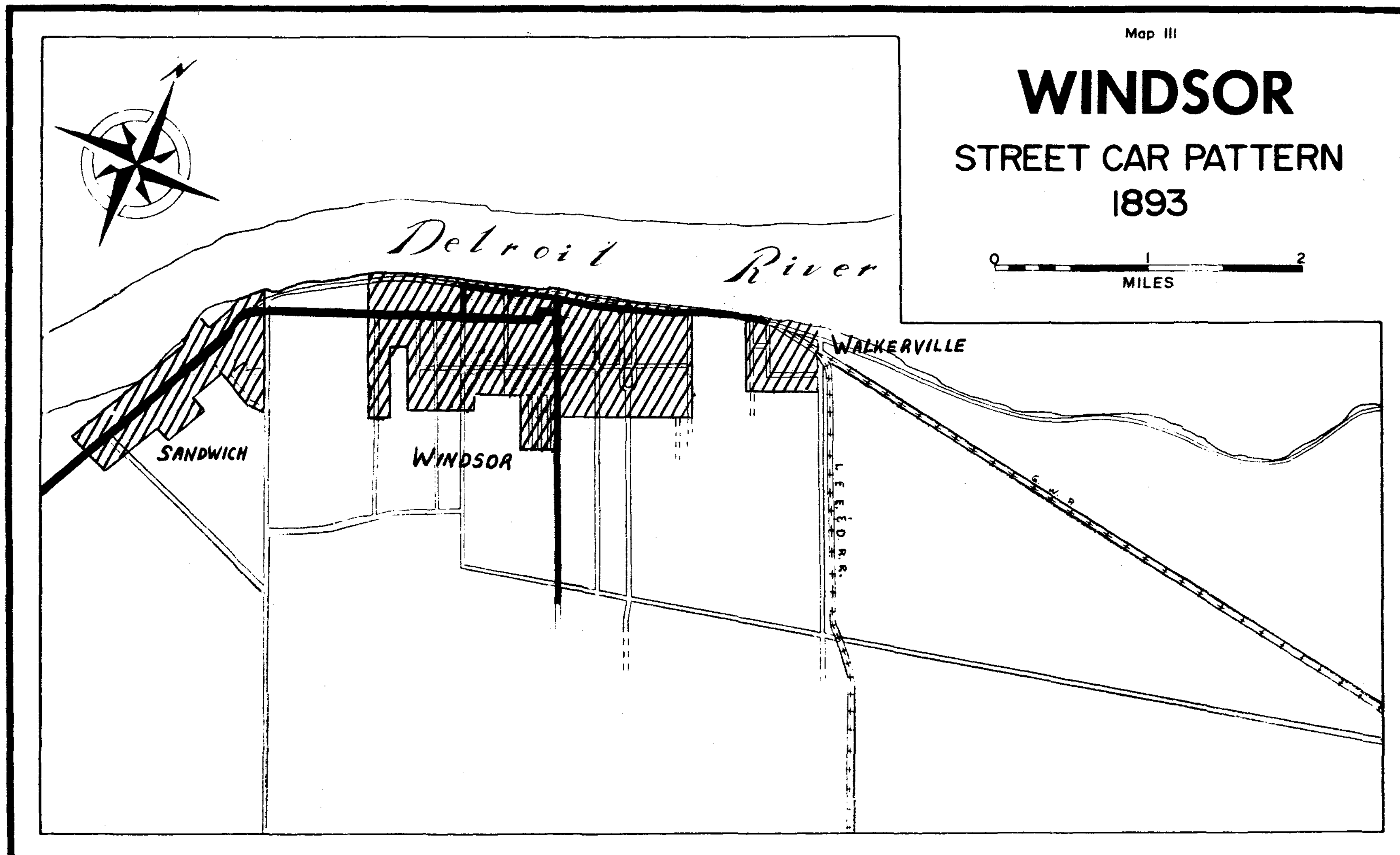
Windsor

The Windsor-Walkerville Street Railway Company and the Windsor-Sandwich Street Railway Company remained separate until 1891. The two companies were then purchased by American interests and combined into one.[16] The new owners joined and rebuilt the two lines and introduced electric service along the entire length during the same year.[17] Two years later the first north-south extension away from the Detroit River was opened along Ouellette Avenue,[18] connecting downtown Windsor with Riding Park, a popular race track during the 1890's and early 1900's. Today the site, located at the corner of Ouellette Avenue and Tecumseh Road, is occupied by Jackson Park. Although the new extension provided transportation mainly for track visitors, it was the first step toward breaking the east-west pattern of linear expansion along the Detroit River. The Ouellette

Avenue line added two miles to the network and produced a third order intersection which increased 'network weight' from 4 to 9 and the Beta value to .77. Opening a new branch was important because it provided access in a third direction and encouraged population to expand in a southernly direction.

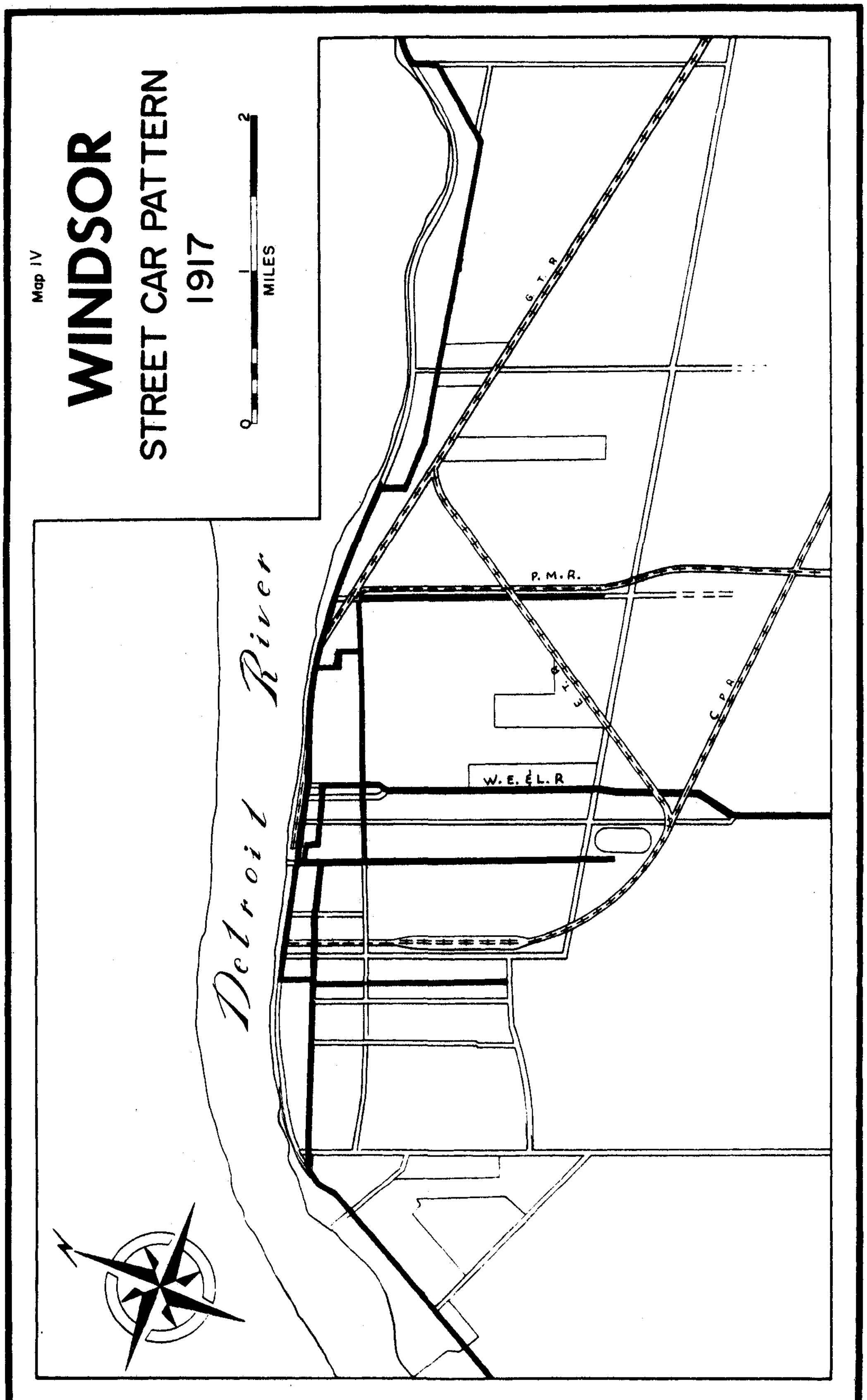
By the end of 1893 a second new line was opened[19] in the city from the corner of Ouellette Avenue along Riverside Drive to University Avenue, (originally called London Street), via Campbell Avenue, (see Map III). As a result of this development a large loop, formed around the central portion of the city, improved connectivity in this area and provided service for the docks along the Detroit River. With the formation of this loop or 'cycle' the network progressed beyond the basic 'tree' pattern, raising Beta values from .77 to 1.00 and the network weight from 9 to 21, (see (Tables 3 and 4).

Originating as an inter-urban system, public transportation in the Windsor area developed a greater mileage than had it been concentrated in Windsor alone. In 1921, (Map IV), the entire length measured 37 miles, (Table 4). Between 1893 and 1921 the Sandwich line was extended as far as Amherstburg at one end and as far as the town of Tecumseh at the other,[20] a distance of nearly twenty miles. Thus, the portion of the network serving the area in question was only seventeen miles in length.


Map III
WINDSOR
STREET CAR PATTERN
1893
0
1
2
MILES
N
Detroit River
SANDWICH
WINDSOR
WALKERVILLE
L. E. E. & D. R. R.
G. W. R.

The expansion of Sandwich, Windsor, Walkerville and East Windsor to a point where they were nearly one, could not alter the effects of early nucleation that were still in evidence by 1917. The main east-west links within the transportation systems of the Border Cities[21] remained along Riverside Drive, London Street and Wyandotte Street, (Map IV). The north-south extensions existed only in areas of heaviest population, as along Howard, Ouellette and Campbell Avenues in Windsor and along Walker Road in Walkerville. Along Walker Road numerous homes and several heavy industries insured continuing patronage from workers and residents. The absence of east-west connectives along the southern extremities of the system testified to the fact that pockets of heavy population, separated by vacant fields, were common. The area between Howard Avenue and Walker Road, south of Wyandotte Street was one such example.

South of Tecumseh Road the only residential growth to be found existed in small pockets along Howard Avenue, Walker Road and around the Roseland Golf and Country Club. Construction of homes along Howard Avenue had been made possible by the opening of the Windsor Essex and Lakeshore Railway Company which provided transportation into Windsor. Before the amalgamation of the Border Cities in 1935, the W.E. & L.R., often referred to as "The Farmers' Railway", operated between Windsor and Leamington via Essex and Kingsville.[22] Although it was not part of the S.W. & A.R. system it used thier rails within the downtown areas. The


Map IV
WINDSOR
STREET CAR PATTERN
1917
0
1
2
MILES
Detroit River
G.T.R
P.M.R.
E.T.R
C.P.R
W.E.&L.R

W.E. & L.R. went out of business at the end of 1934[23] and its portion of rails within the city was incorporated into the network.

Residential growth along Walker Road began early as the thoroughfare was an important link between Hiram Walker's farms and orchards and distillery. Many homes, therefore, belonged to the farme workers who lived in the vicinity.

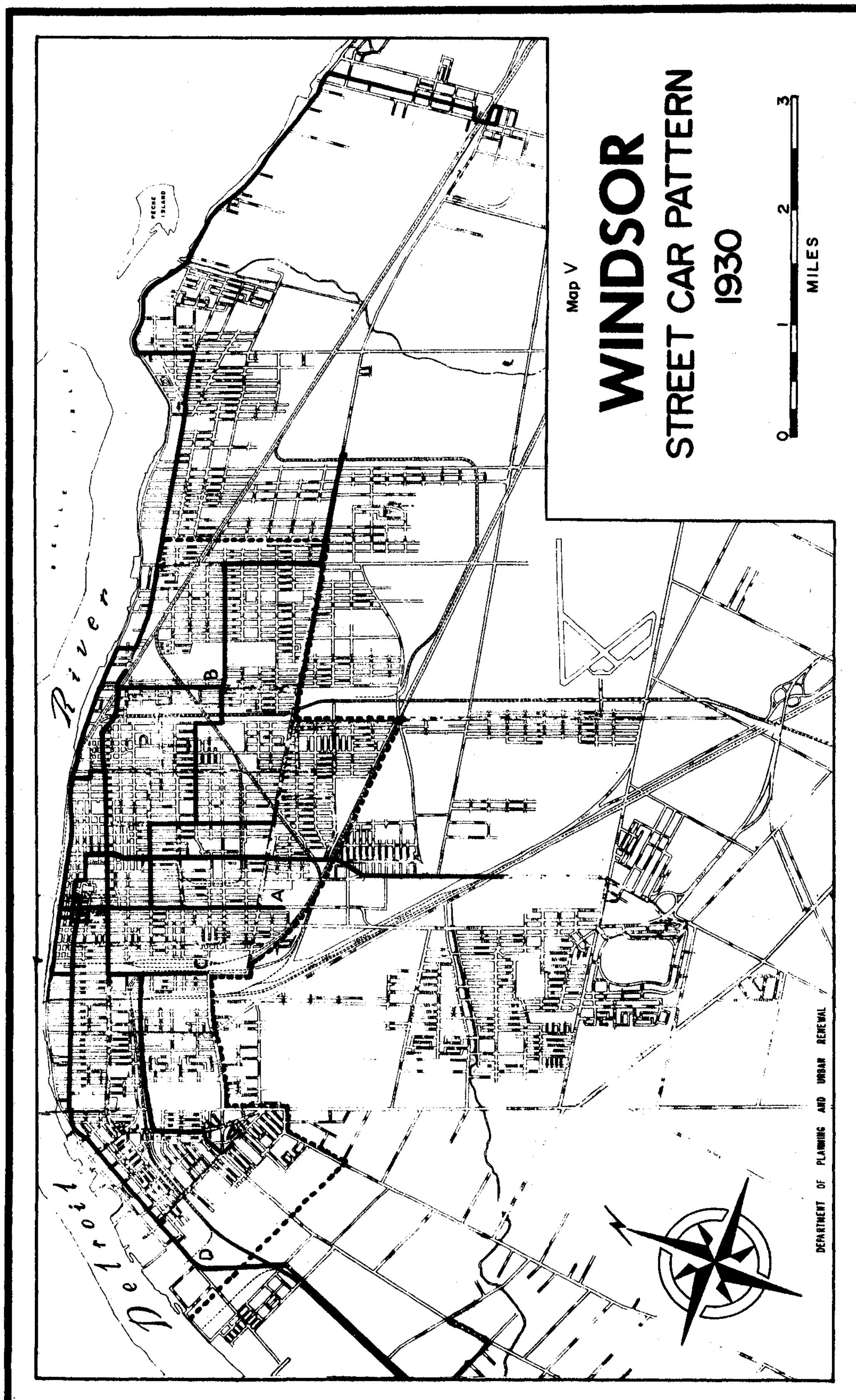
Roseland Golf and Country Club, built during the early 1920's, became a focus around which many higher priced homes appeared. As there was no public transportation between Windsor and the country club, only residents with automobiles moved in. Dougall Road provided a rapid link with the center of the city. Because there was no public transportation in the vicinity, the Roseland area may well be considered as one of the earliest suburbs of Windsor, totally dependent on the automobile. The low density, high income development made streetcar service both unnecessary and uneconomical. Consequently no routes were developed to this community.

During the following decade the S.W. & A. R. continued to expand as twelve miles of rails were added in response to the growing population of the Border Cities, (compare Maps IV and V). By 1930 a large proportion of the new growth occurred in areas which had been vacant land in 1917. Thus with the expansion of the network, (Table 4), the Beta Index was seen to rise from 1.14 in 1917 to 1.33 in 1930. Better connectivity was achieved through the opening of additional east-west links south of Wyandotte Street, east of Ouellette Avenue. Enlargement of the network nearly doubled the 'network weight' by producing several new higher order intersections, thus, permitting freer movement across the city.

Some idea regarding the degree of improvement in connectivity may be obtained from a consideration of Map V. In Map V four points were chosen in various parts of the city and the distance between several pairs of points measured. Results indicated that a person wishing to travel from point 'A' to point 'B' could have done so by streetcar over a route that was three-quarters of a mile shorter than in 1917. Similarly, the distance between 'A' and 'C' and 'C' and 'D' was three-quarters of a mile and one and one half miles shorter, respectively, in 1930, (see Maps IV and V).

Trolley buses had been tried for two or three years before 1930 to discover if they could provide a suitable alternative to the streetcars, which even by this time had become wornout and expensive to maintain. However, after a few years of testing and experimentation with the trolley buses the company decided that they were just as rigid as the streetcars, and took them out of service.[24]

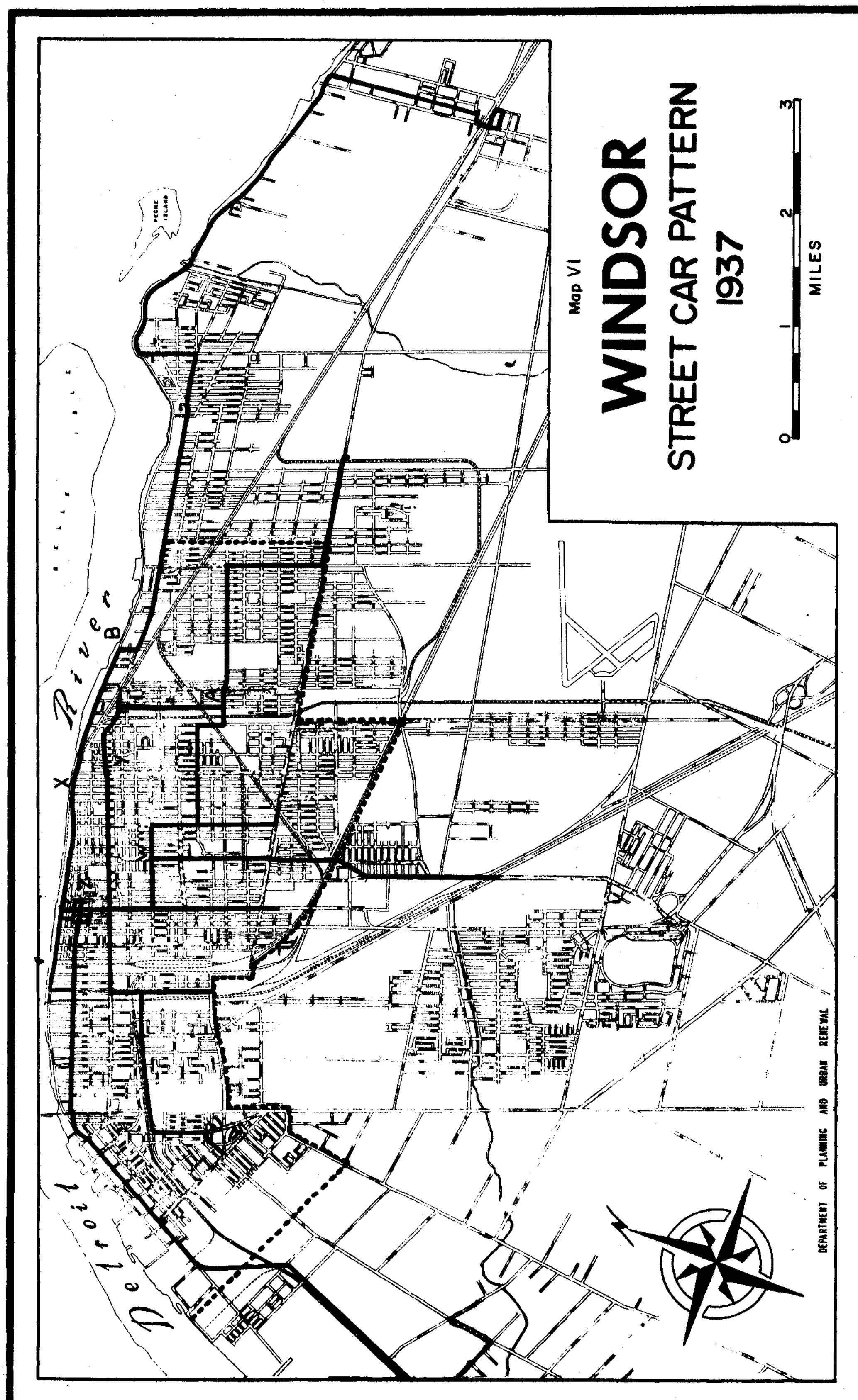
Beset by financial difficulties as the depression of the 1930's began, the S.W. & A.R. was forced to reduce service along some of the less profitable lines,[25] a common problem in many cities during this time.[26] Thus, by 1937


Map V
WINDSOR
STREET CAR PATTERN
1930
0
1
2
3
MILES
Detroit River
BELLE ISLE
PECHE ISLAND
DEPARTMENT OF PLANNING AND URBAN RENEWAL

overall connectivity in Windsor declined from a Beta value of 1.33 in 1930 to 1.05 in 1937, while the total weight of the network was similarly affected, (see Table 4). Theoretically, a decrease of 0.28 in the Index is significant when one remembers that the range of values fluctuates from 0.00 to 3.00, and that the latter represents infinity.

Elimination of the connective between 'X' and 'Y' added nearly three miles to the distance between 'A' and 'B'. Elimination of a connective between 'Z' and 'W' produced similar results. Thus, according to graph theory, the suspension of service along these sections of the network appeared more serious than it really was. The link between 'X' and 'Y' represents a distance of only two blocks, a short walk for anyone wishing to transfer from one streetcar to another. In the second example, suspension of service between 'Z' and 'W' meant that residents along Howard Avenue were forced to take the Ouellette Avenue, Erie Street or Wyandotte Street cars. With most residents this again represented a minor increase in walking distance, (see Map VI).

During the 1930's the governments of the Border Cities also experienced financial difficulties. As a result, in 1935 at the point of bankruptsy, the four communities of Sandwich, Windsor, Walkerville and East Windsor merged into the city of Windsor to form a single municipality. Being in a bad economic state itself, the city of Windsor could not provide any assistance to the S.W.& A.R.. The latter,

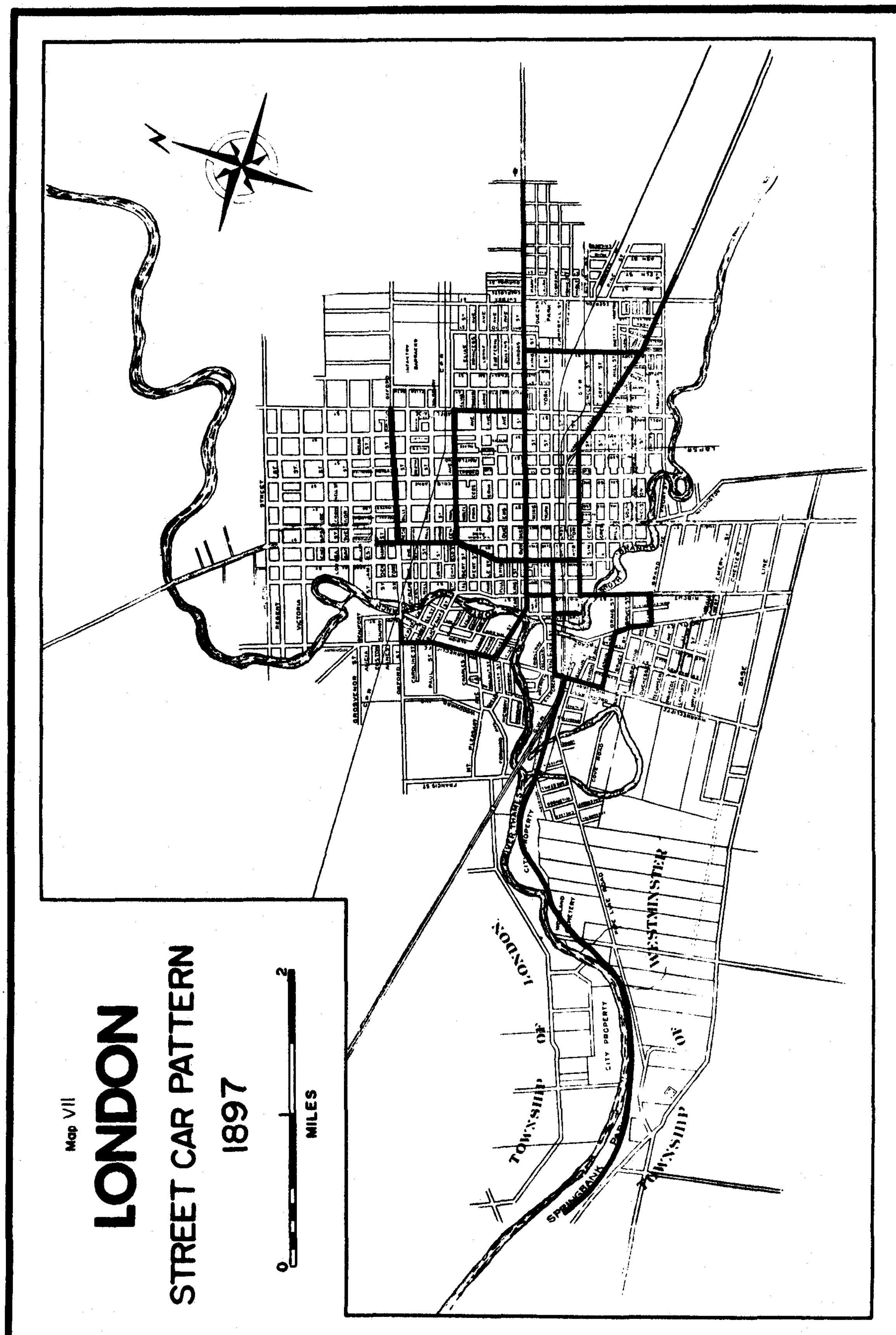

Map VI
WINDSOR
STREET CAR PATTERN
1937
0
1
2
3
MILES
Detroit River
PECHE ISLAND
DEPARTMENT OF PLANNING AND URBAN RENEWAL

burdened with deteriorating rails and equipment was eventually forced to abolish the streetcars and convert to buses.because it was discovered that a new fleet of buses did not cost as much as it would have cost to rehabilitate the streetcar network. This problem is discussed further, in Chapter III.

London

An outstanding characteristic of London's public transportation, in contrast to Windsor, was its rapid growth from the time it became electrified in 1895[27] to 1909. By this date the London network attained near maximum length and connectivity and remained almost unchanged until buses were introduced in 1945. A partial explanation for this high degree of stability may be found in the knowledge that the physical size of the city changed very little during these years, (Table 2). On the other hand the population continued to increase within this fixed area. Thus, once a suitable pattern of routes was developed, it was only a matter of introducing a larger number cars on each line to keep pace with the growing population. Although higher population densities did not seem to affect the size and shape of the streetcar network in London, they certainly must have had some affect on frequency of service and profits.

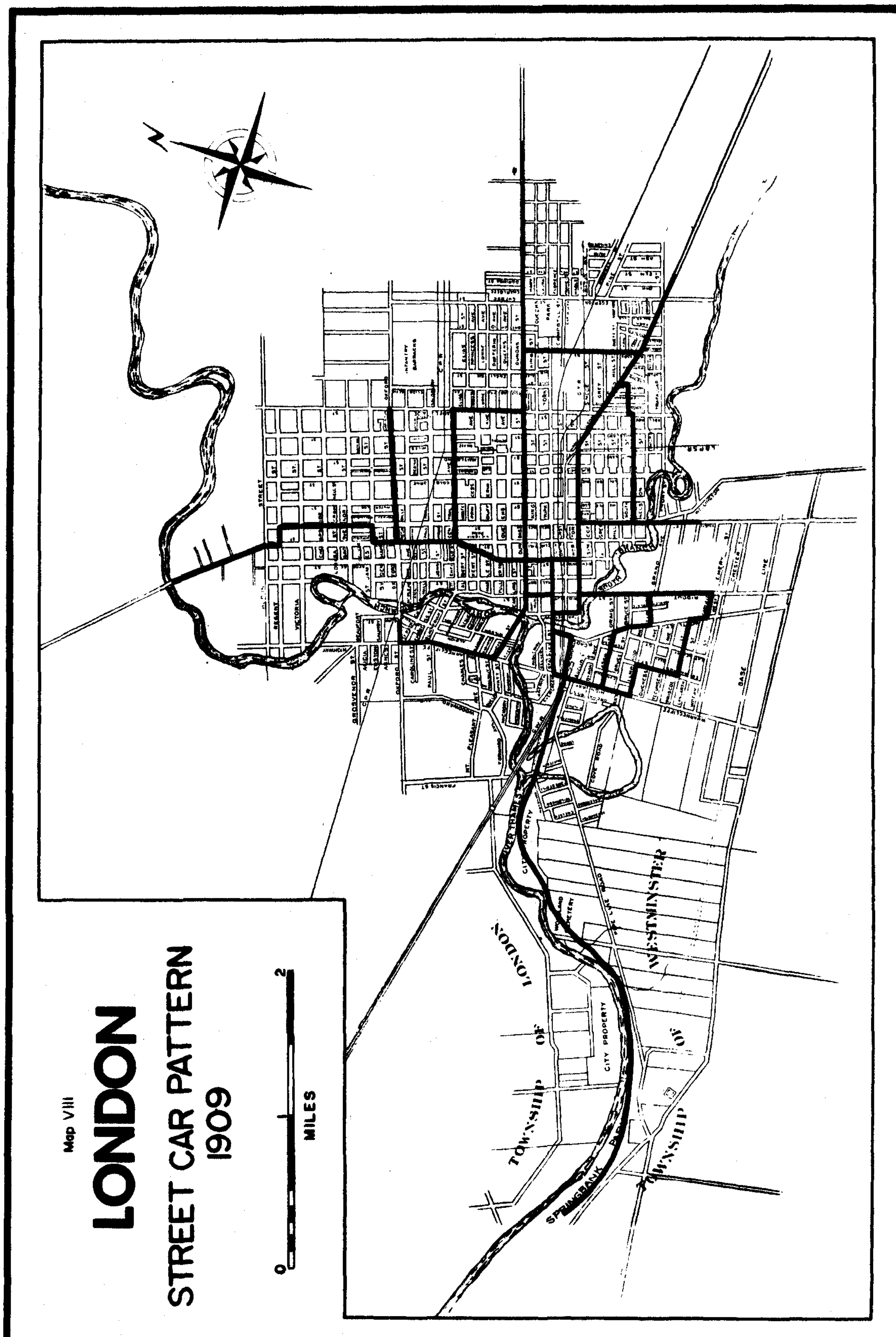
Addition of new lines by 1897, (Map VII), resulted in greater connectivity and the appeareance of several new higher order intersections, (Table 4). The change from

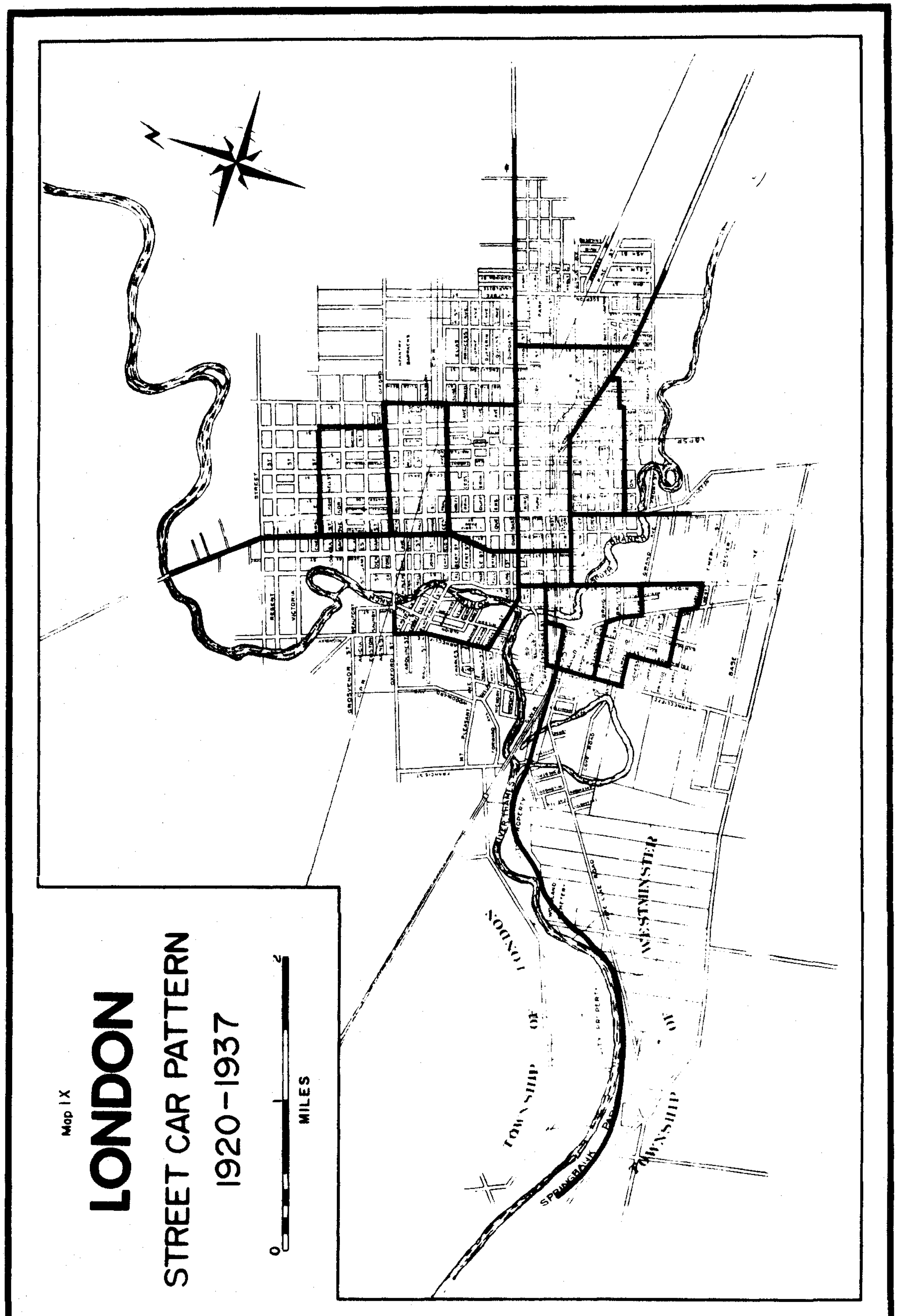

Map VII
LONDON
STREET CAR PATTERN
1897
0
1
2
MILES
TOWNSHIP OF LONDON
TOWNSHIP OF WESTMINSTER
CITY PROPERTY
SPRINGBANK PARK

horse-trams to electric streetcars permitted London to add 12.25 miles to its network, expanding the total mileage from 6.25 in 1893 to more than 18 miles by 1897. By 1909 this figure had increased even further, to 23 miles. At the same time the Beta Index rose to 1.24. A comparable rise in network weight may be discovered in Table 4.

A comparison of Windsor in 1917 and London of the same year, (Maps IV and VIII), reveals that Windsor was less developed than London. Not only was the Beta Index higher for London's network, but the difference was particularly evident when the number of higer order vertices was considered in each case. Although both had six first order vertices, London had seventeen third order and two fourth order intersections in 1909, producing a total weight of 124. In Windsor, only seven third order and one fourth order vertices were evident as late as 1921, producing a total weight of only 56. As a larger number of high order vertices meant greater carrying capacity, the difference between a total weight of 56 in Windsor compared to a total weight of 124 in London, was significant. This condition indicated that Windsor's public transportation network in 1917 was less developed than the London network in 1909.

The radial, or branching pattern exibited by the Windsor network illustrated the scattered nature of the Border Cities. Each community had a tendency toward independent growth. London, on the other hand, was far


Map VIII
LONDON
STREET CAR PATTERN
1909
0
2
MILES
TOWNSHIP OF LONDON
TOWNSHIP OF WESTMINSTER
SPRINGBANK PARK
CITY PROPERTY


Map IX
LONDON
STREET CAR PATTERN
1920-1937
0
1
2
MILES

more compact, illustrated by a greater density of lines and interconnections found within the city limits. A branching pattern, such as the one in Windsor implied, not only clustering of population, but a strong interaction between the center and its outlying vertices, though very weak interaction among the vertices, themselves. In contrast to Windsor, the development of interstitial links in London between the radial lines indicated much stronger interaction throughout the system, (Map IX).

CHAPTER II

NOTES

1. Fredrick Niel, "Sandwich, Past and Present", Evening Record. (May 23, 1917)., claims that public transportation began operating between Windsor and Sandwich in 1872. Six new cars had been purchased by the Sandwich-Windsor Street Railway Company and placed in service during that year. In London horse drawn transportation began in 1875, according to the London Free Press article, "Some Interesting Facts Showing the Growth of London and City Transportation", London Free Press. (April 23, 1936).

2. "Windsor History", Centenial Supplement, Windsor Daily Star. (August 14, 1954).

3. Neal F. Morrison, Garden Gateway to Canada. (Toronto, 1954),

4. Neil F. Morrison claims that on a typical summer day it was common for as many as ten thousand Windsorites and Detroiters to arrive in Sandwich to enjoy the mineral springs. This figure seems exagerated, nevertheless Sandwich must have been popular, Niel F. Morrison, Garden Gateway to Canada. (Toronto, 1954), p.

5. Fredrick Niel, "Sandwich, Past and Present", Evening Record. (May 23, 1917).

6. Ibid.

7. Norman D. Wilson, "Some Problems of Urban Transportation", Essays in Transportation. (Toronto, 1941), p.

8. Ibid.

9. Annual Report of the Assessment Department for the City of Windsor, (Dec. 31, 1968), p. 14.

10. "Some Interesting Facts Showing the Growth of London and City Transportation", London Free Press. (April 23, 1936).

11. Ibid.

12. Ibid.

13. K. J. Kansky, Structure of Transportation Networks:

Relationships Between Network Geometry and Regional Caracteristics. (Chicago, 1963), p. 28.

14. Ibid., p. 28.

15. Ibid., p. 28.

16. "Stage Coach to Motor Bus", Windsor Daily Star. (August 1, 1942).

17. Ibid.

18. Ibid.

19. Ibid.

20. Fredrick Niel, "Sandwich, Past and Present", Evening Record. (May 23, 1917).

21. Until the merger in 1935 the four communities of Sandwich, Windsor, Walkerville and East Windsor were known as the Border Cities.

22. "The Rise and Fall of Areas W.E. & L.S.", Windsor Daily Star. (December 24, 1965).

23. Ibid.

24. Interview with Mr. J. A. Norry, Research and Development Division, Sandwich, Windsor and Amherstburg Railway Company, (September, 1968).

25. Ibid.

26. Mildred M. Walmsley, "The Bygone Electric Inter-Urban Systems", The Professional Geographer. (May, 1965), p. 4.

27. "Some Interesting Facts Showing the Growth of London and City Transportation", London Free Press. (April 23, 1936).

CHAPTER III

STAGE 2 -- BUS TRANSPORTATION

(A) -- Early Development, 1936 to 1950

Windsor

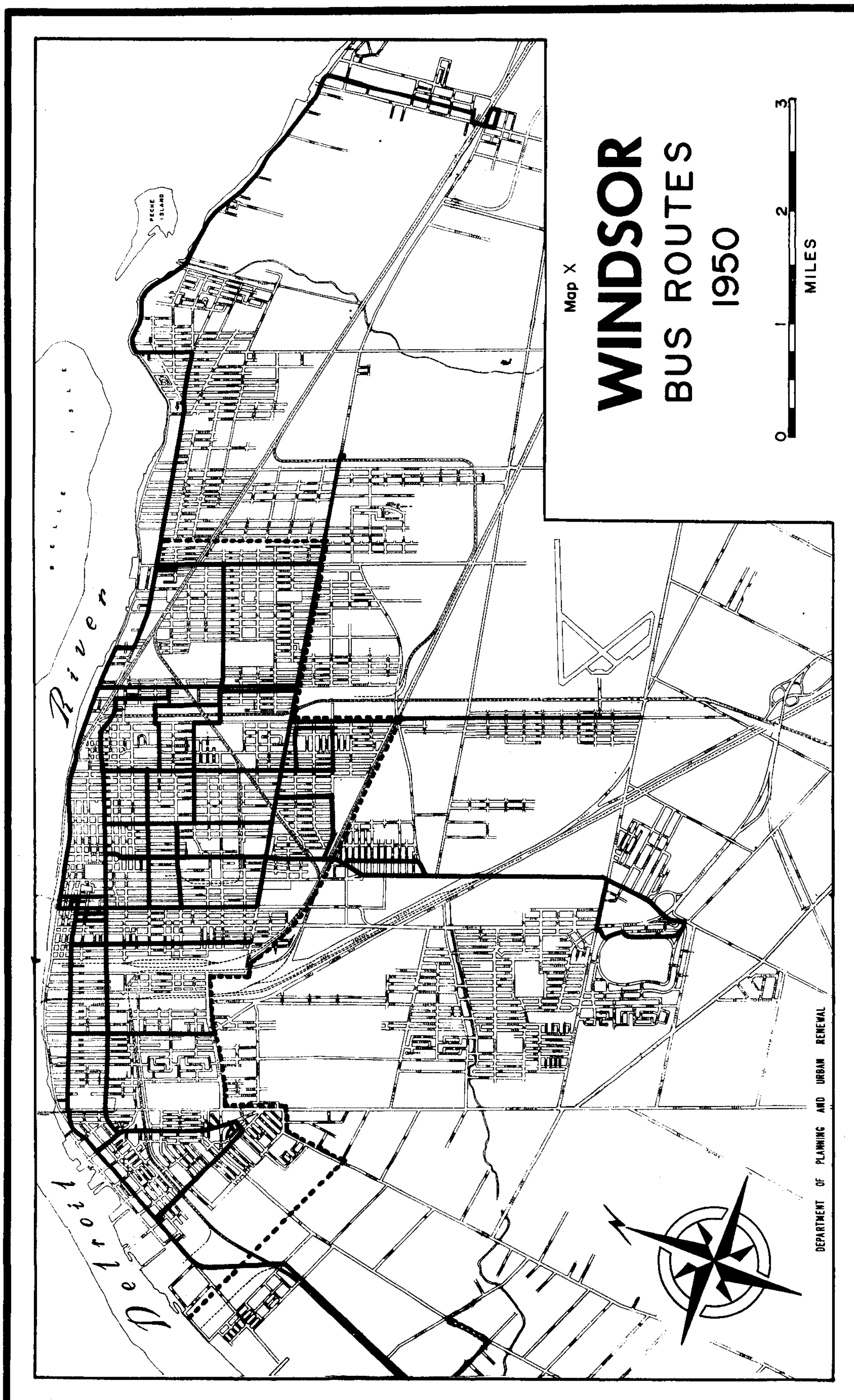
By the mid 1930's the Sandwich, Windsor and Amherstburg Railway Company, along with other public transportation companies in Canada, was faced with a serious problem resulting from outdated equipment and worn-out rails and wiring.[1] In addition, automobiles were becoming more numerous, and provided some competition to public transportation. From a figures of 535 vehicles registered in Canada in 1905, registrations soared to 1.2 million by 1940.[2] In 1936 Windsor, alone, had 14,295 automobiles registered, while in London there were 12,485.[3] The population of Windsor in 1931 was 63,108. By 1936 it was estimated at about 75,000. This means that there was approximately one automobile for every five residents in the city.

The Detroit Street Railway Company, on the other side of the Detroit River, was experiencing similar difficulties as Windsor and had invested large sums of money toward an exhaustive study of Public transportation.[4] By using the findings of this study the S.W. & A.R. concluded that it would cost more money to rehabilitate the existing electric system than it would to purchase a new fleet of buses.[5]

Consequently, buses were introduced in 1938 and by the end of 1939 had replaced all streetcars. A period of route testing followed to discover the most suitable pattern for the new bus routes.[6] Thus, for the next few years the system was constantly changing. Although no record of these changes could be obtained, by 1950 a stable network seems to have emerged, (see Map X).

Buses brought new flexibility to public transportation in Windsor and London, impossible to achieve with electric transit. Unrestricted by rails and wiring buses were free to change routes at any time. To avoid traffic congestion resulting from fires, accidents or road construction, became a simple matter. At the same time, elimination of expensive rails and electric wiring permitted introduction of bus service in outlying or sparsely populated areas of the city. In addition, buses began to operate along streets of secondary importance, increasing the density of lines.

In the eastern half of the city three new north-south routes appeared, (see Map X). Buses along these arteries operated from Riverside Drive in the north to Tecumseh Road in the South, forming direct links between the northeastern and southeastern quadrants. In the west, however, slow residential growth had retarded the development of transportation lines. Much of the land only a short distance south of Wyandotte Street, west, was still vacant fields in the region between Huron Line and the C.P.R. tracks. There-


Map X
WINDSOR
BUS ROUTES
1950
0
1
2
3
MILES
PECHE ISLAND
BELLE ISLE
Detroit River
DEPARTMENT OF PLANNING AND URBAN RENEWAL

fore, the density of lines in the western portion of the city was correspondingly lower, giving the network a somewhat unbalanced appearance, (Map X).

Probably the most important development in Windsor during the early stages of bus transportation took place when the north-south lines in the eastern portion of the city were connected along Tecumseh Road to form a complete grid. As a result, many passengers who wished to reach destinations along Tecumseh Road were able to do so directly, eliminating many of the time consuming trips through the downtown. Needless to say, the increase in route densities and connecting of route endpoints around the perimiter, greatly improved connectivity by 1950, (see Table 3). Heavier route densities, supported by increases in network weight, (Table 4), brought the service much closer to the public.

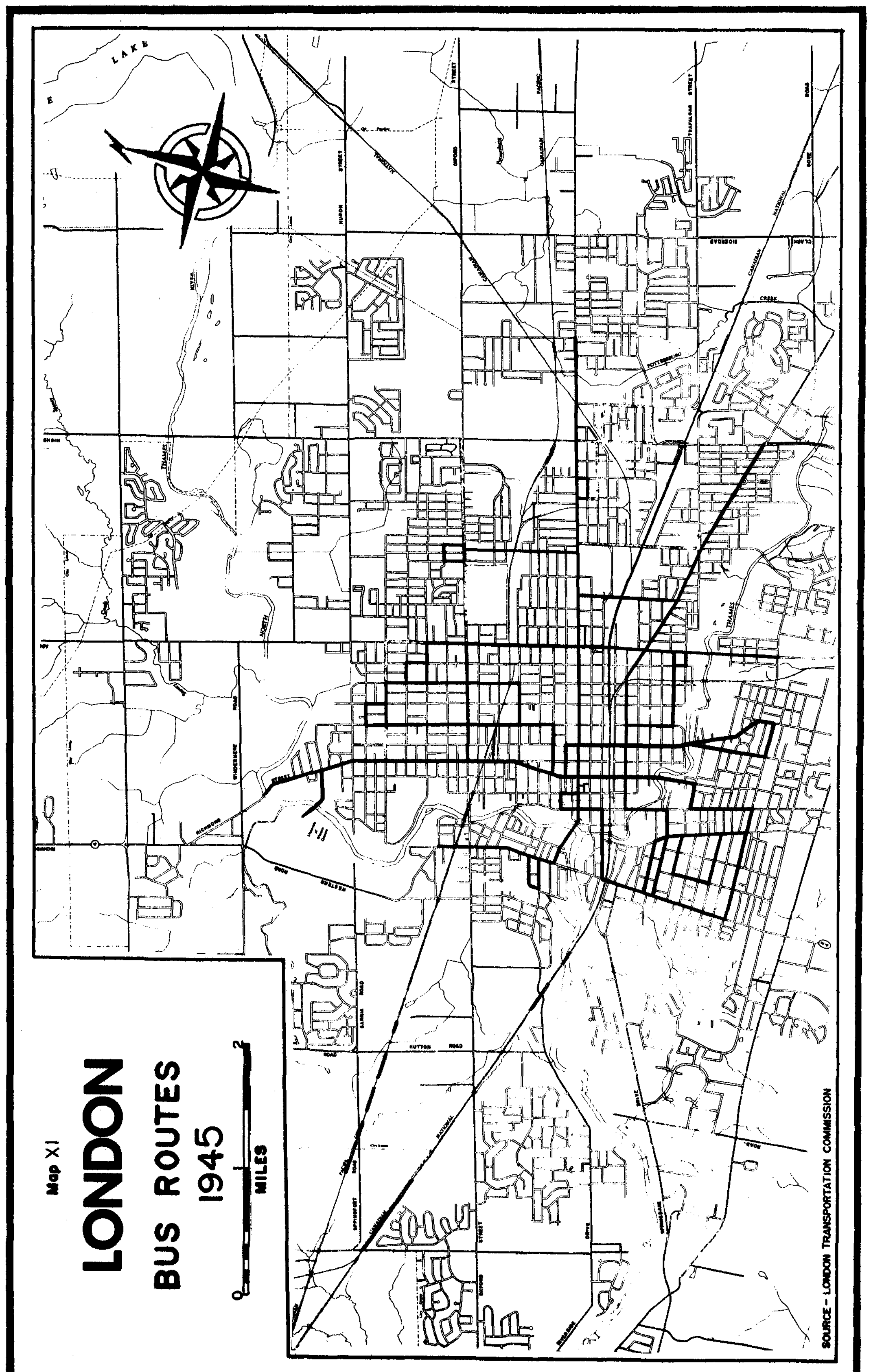
Expansion of the network between 1937 and 1950, (compare Maps VI and X), resulted in a doubling of route mileage from 32 to 64 miles, (Table 4), although the city limits remained the same. This means that by 1950 an area of constant size was being served by twice the route mileage. Assuming that the frequency of schedules operating along each line had remained the same as in 1937, one may conclude that the service had improved on hundred per cent.

Although details of scheduling could not be obtained, bus operation must have been frequent as the S.W. & A.'s records point to 1946 as a peak year during which a total of 44,630,192 passengers were carried.[7] The high patronage was attributed to a post-war shortage of gasoline and tires,[8] discouraging the use of private automobiles. However, after 1946 patronage began to decline steadily as more and more people again turned to the automobile. By 1968 patronage had decreased to 12,344,378,[9] despite the fact that the total population of metropolitan Windsor had increased from 121,211 in 1941[10] to 211,000 in 1966.[11]

London

In contrast to Windsor, London maintained a very stable electric system until 1945. However, buses had been introduced long before, often operating in outlying areas where population densities were lower, or supplementing the streetcars in the city during the busy periods of the day. The number of buses gradually increased over the years until all street cars were finally replaced by 1945. Probably buses operated along secondary streets before 1945, perhaps even in the 1930's, but records could not be obtained to support this assumption. Nevertheless, use of buses in conjunction with streetcars might serve to explain why London's electric network remained unaltered for so many years. Without buses the electric system, formed in 1909, could not possibly have been adequate in the 1930's.

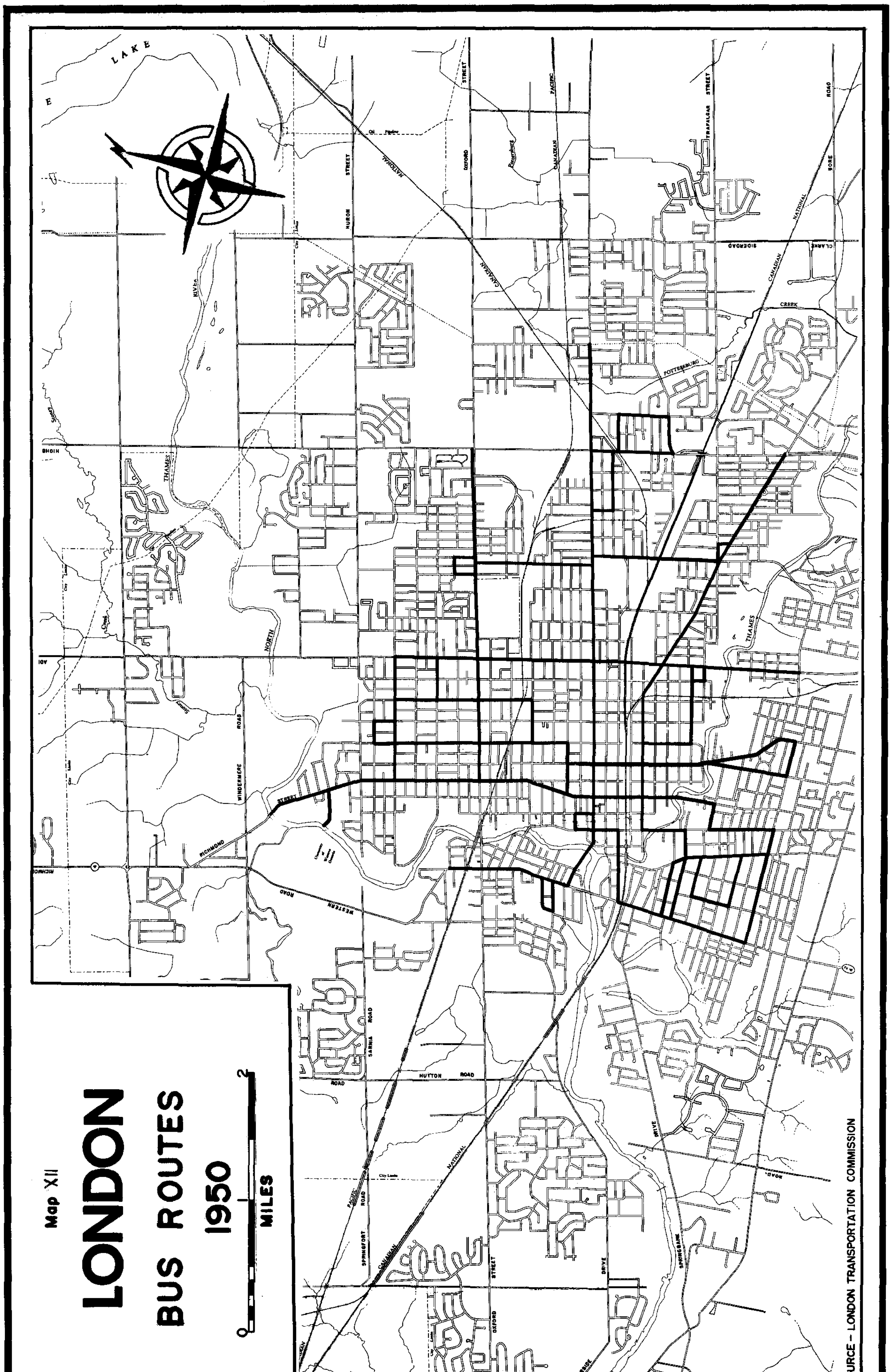
The size and complexity of the bus network in 1945, (see Map XI), provided further proof that buses were in use for many years prior to this date. However, in 1945 the


Map XI
LONDON
BUS ROUTES
1945
0
1
2
MILES
SOURCE - LONDON TRANSPORTATION COMMISSION

network appeared crude compared with the same network five years later, (compare Maps XI and XII). In 1945 a series of steps and loops in the northeastern portion of the system near Cheapside and Waterloo Avenues, indicate some instability. The loops, which represented endpoints of individual lines, were too close together, suggesting that some streamlining was required. By 1950 these lines were combined to produce a more stable pattern.

During the same five years several new east-west extensions were formed east of Richmond and north of Dundas Streets in response to additional population growth. In the southeast the presence of industry had retarded residential development. West of Richmond Street the Thames River probably had a similar effect as very few bus lines were in evidence. Thus, by 1950 London too, had developed a relatively stable network in much the same manner as Windsor.

Between 1937 and 1950 the connectivity of the system improved greatly, (see Table 3). Increases in connectivity may be attributed to the opening of new routes within the city as well as to the introduction of connectives around the perimeter. Increases in route densities, between 1937 and 1950, created a large number of high order intersections, widening the systems potential carrying capacity, (Table 4). Consequently, the service offered to the public as a result of the changeover from streetcars to buses improved a great deal.


Map XII
LONDON
BUS ROUTES
1950
MILES
SOURCE - LONDON TRANSPORTATION COMMISSION

(B) -- Later Developments, 1950 to 1968

Introduction -- Affects of Suburbanization

During the 1950's and 1960's large scale suburbanization changed the size and shape of Windsor and London to a considerable extent. Suburbanization began primarily during the 1950's and quickly became a trend evident in most North American cities. In 1900 Canada's population was approximately two thirds rural.[12] Today, nearly eighty per cent of all Canadians live in urban communities.[13] One of the main features of post-war suburbanization has been a, "tendency to discontinuity -- large, closely settled areas intermingled haphazardly with unused areas".[14] This lack of continuity has resulted in the term "sprawl", being applied to the hit-or-miss character of the suburbs.[15]

In their simplest form suburbs represent a desire on the part of urban populations to escape from the congestion and the bustle of the city to the peace and quiet of the countryside. For most, this is an impossibility for reasons such as limited finances, problems of education for the children, distance to shopping, employment, etc. For a majority of such residents the suburbs offer an acceptable medium where one can live more peacefully yet still enjoy the benefits of urban life. Secondly, the migration to the suburbs reflects a general lack of building space within the core of the old city, forcing development elsewhere.

During the 1950's suburbs developed outside of the city limits of Windsor and London, beyond effective municipal control where taxes and land costs were lower.[16] By living in the suburbs while working in the city many were able to evade the higher taxes, yet continue to use the services provided by the city such as roads, water, education, shopping, entertainment, etc. Faced with these dilemas many cities, Windsor and London included, found it necessary to annex the surrounding regions.

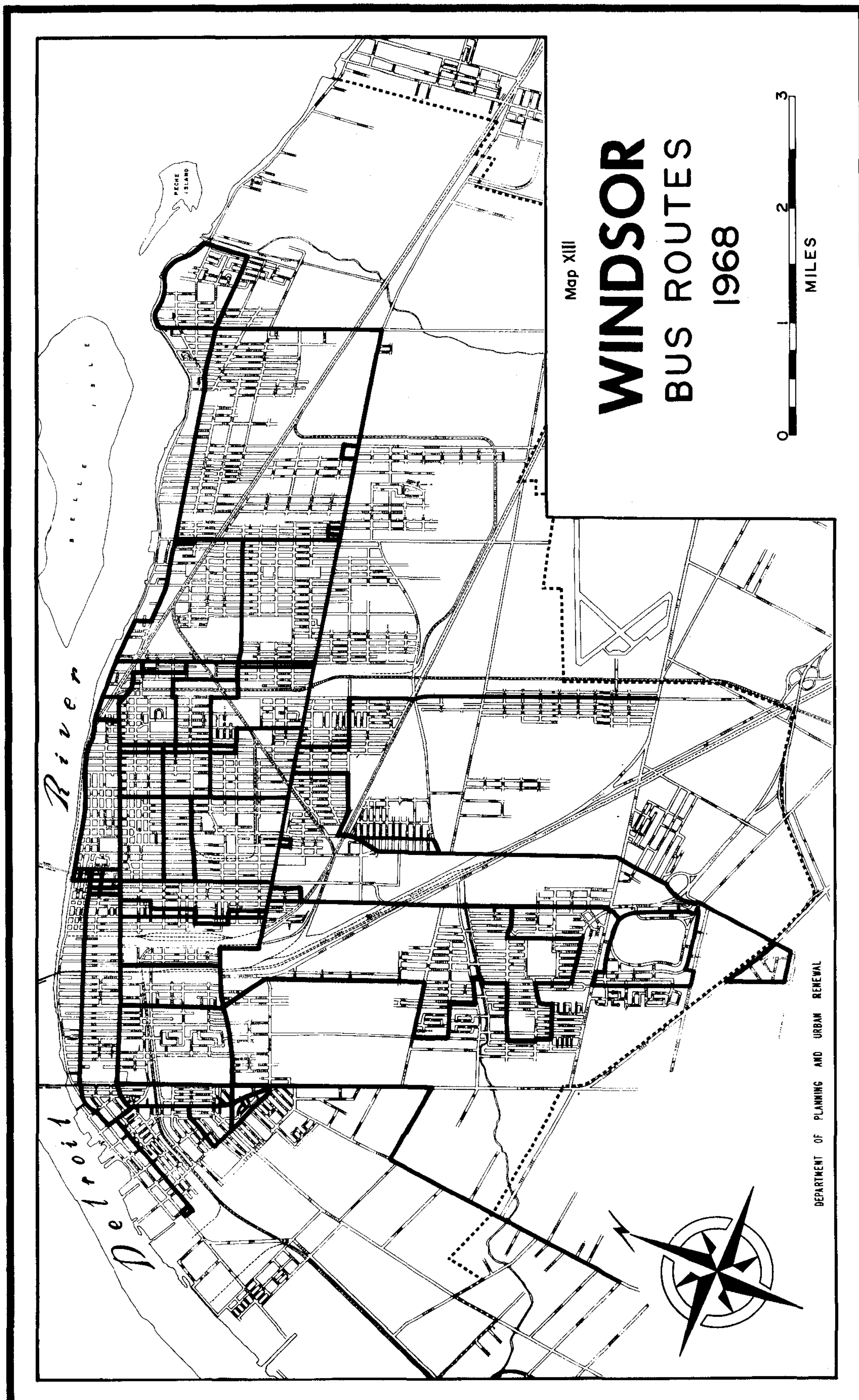
Windsor

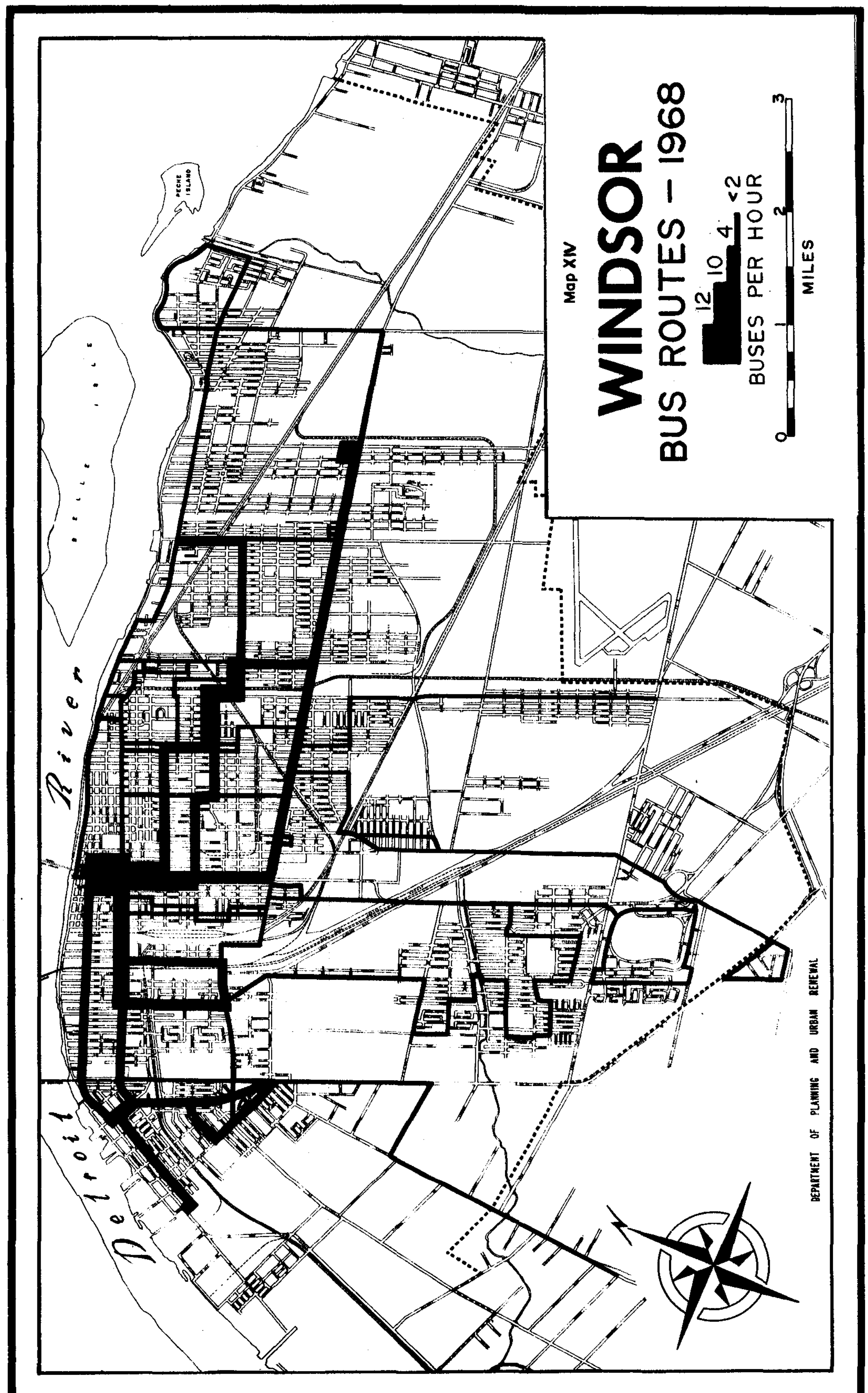
Annexation of surroundings in 1966,[17] forced the expansion of bus service into suburbs long dependent upon private transportation, (Map XIII outlines the extent of bus routes in south Windsor). In many cases these residents had acquired a second automobile and continued to use it in spite of introduction of a public transit system. Scattered suburban development characterized by limited use of public transportation facilities, burdened the S.W. & A. with the task of providing services into low-profit and even negative-profit areas. Consequently, Windsor's suburban bus lines strongly resemble the radial pattern produced by streetcars in the old core thirty years ago. However the C.B.D. was the focal point for the streetcar network, whereas for the bus network the entire core became the focus, (compare Maps XIII and VI).

Taking this comparison a step further, it was discovered that a flow map, (Map XIV), based on the number of buses per hour over each route, closely resembled the streetcar system illustrated in Map VI. (A list of the bus frequencies for 1968 is provided in Table 5. The routes used during the 1930's have remained as high density routes today. All high density routes are still within the area enclosed by the pre-1966 boundries of Windsor. All lines beyond the city limits are poorly used and therefore low-density. In addition, all bus shcedules still come into the downtown regardless of origin or destination, indicating that the C.B.D. is still very important.

A 1961 traffic study conducted for metropolitan Windsor[18] revealed very heavy traffic flows along Huron Line, Dougall Road, Howard Avenue and Walker Road, (see Map XV). Bus lines along these same streets maintained schedules at a low frequency of less than two buses per hour. Although a large proportion of this traffic flow may be attributed to commercial and through traffic, as these streets connect with major highways and the two border crossings to the United States, the remaining flow must be composed of suburban traffic. (compare Maps XIV and XV).

It is interesting to note that most of the heavy traffic flow, (illustrated on Map XV), seemed to end at Tecumseh Road, which serves as the main east-west artery across the city. Wyandotte Street and Riverside Drive, the only other crosstown streets were also heavily travelled. With the exception of Ouellette Avenue and small portions of Wyandotte Street and Tecumseh Road, the streets which support the lowest bus frequencies maintained the highest


Map XIII
WINDSOR
BUS ROUTES
1968
0
1
2
3
MILES
Detroit
River
BELLE ISLE
PECHE ISLAND
DEPARTMENT OF PLANNING AND URBAN RENEWAL



Map XIV
WINDSOR
BUS ROUTES — 1968
12 10 4 <2
BUSES PER HOUR
0 1 2 3
MILES
Detroit River
BELLE ISLE
PECHE ISLAND
DEPARTMENT OF PLANNING AND URBAN RENEWAL

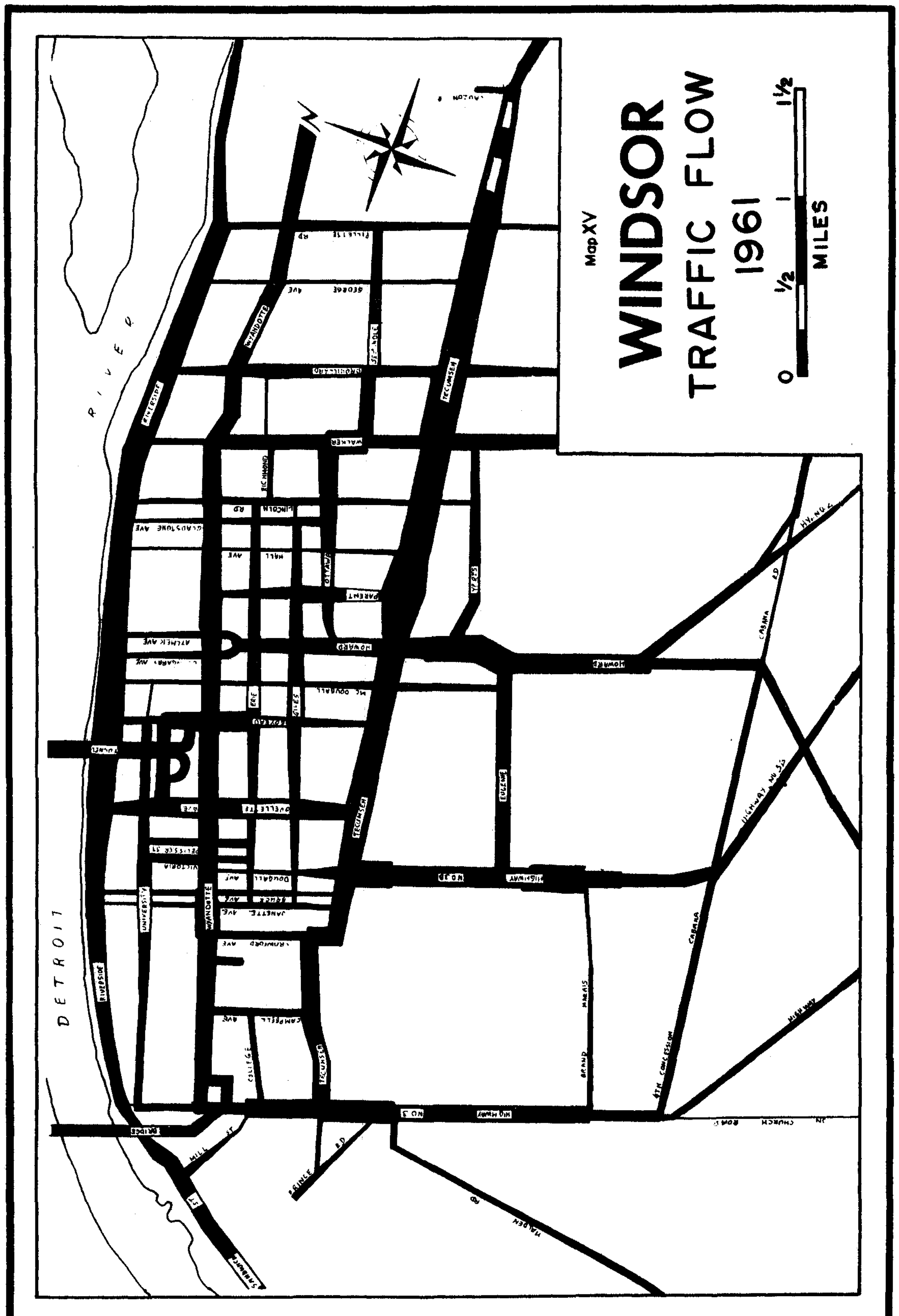

Map XV
WINDSOR
TRAFFIC FLOW
1961
0 1/2 1 1 1/2
MILES
DETROIT
RIVER

TABLE 5

BUS FREQUENCIES OVER THE WINDSOR NETWORKS
(1968 SCHEDULES)

ROUTES	NUMBER OF BUSES	
	Weekly	Hourly
Wellington-Campbell	444	2.46
Tecumseh West	75	.45
Ouellette	719	4.28
Ottawa	704	4.19
Malden Road	300	1.78
Lincoln	249	1.48
Lauzon Road	399	2.37
Howard Road	96	.57
Erie Street	424	2.52
Dougal Road	54	.32
Dominion Boullevard	60	.35
Bruce Avenue	190	1.13
Crosstown	572	3.40
Riverdale	379	2.25
Highway #2	80	.48

HIGH DENSITY .... More than 3.00

HIGH MEDIUM DENSITY .... 2.01 to 3.00

LOW MEDIUM DENSITY .... 1.01 to 2.00

LOW DENSITY .... less than 1.00

Source - Sandwich Windsor and Amherstburg Railway.Company.

traffic flows.

The lack of patronage in the outskirts, especially in south Windsor, has forced the S.W. & A. to introduce a number of large loops and meanders through the side streets in such areas. In this manner they have attempted to bring the service closer to the consummer in the hope of collecting the necessary fares, (Map XIII). In spite of this the patronage has continued to decline in these areas.

The effects of suburbanization, together with the expanding use of automobiles, may be noted as the most significant factors which have contributed to the development of bus lines in Windsor since 1950. Other changes which might become evident from a comparison of Maps X and XIII are relatively minor; for the most part representing a filling-in of the core area, as in west Windsor, where vacant land still existed. Extension of a bus line along Tecumseh Road west, connected several of the north-south routes, improving connectivity in the western regions of the city between the C.P.R. tracks and Huron Line.

Even though connectivity in the core area had improved with the addition of the new line along Tecumseh Road west, the Beta Index reflected a slight drop, (Table 3), because the Index measures total connectivity. Thus the radial expansion in the suburbs, which is not conducive to high Index values, has caused the decrease in overall connectivity. However, the degree of expansion experienced by the network is readily evident upon examination of Table 4, which reveals that route mileage increased from 64 to 95 miles from 1950. Similarly, the total weight of the network has also increased, improving the system's capacity to handle larger volumes of traffic, (see Table 4).

Other changes, evident between 1950 and 1968, are primarily a result of the rerouting which became necessary following a reorganization of some Windsor streets to handle one-way traffic. Thereafter, buses using these arteries were forced to use adjoining streets when movement would have been against the flow of one-way traffic.

London

Basically, the same factors observed in Windsor were to be detected in London as well. The stability of London's city limits was broken by 1968 as suburban growth appeared on all sides, contrary to Windsor where suburban growth was confined only in the south and in the east. Therefore, the introduction of buses into the outlying suburbs of London produced a cart-wheel effect in its network with the core serving as the focus, (see Map XVI).

The London system exhibited an even higher degree of looping than Windsor because of the larger number of small suburban clusters. Within each cluster some meandering was detected, but not for the same reasons as in Windsor. Whereas in south Windsor meandering obviously occurred in an effort to collect as many passengers as possible, in

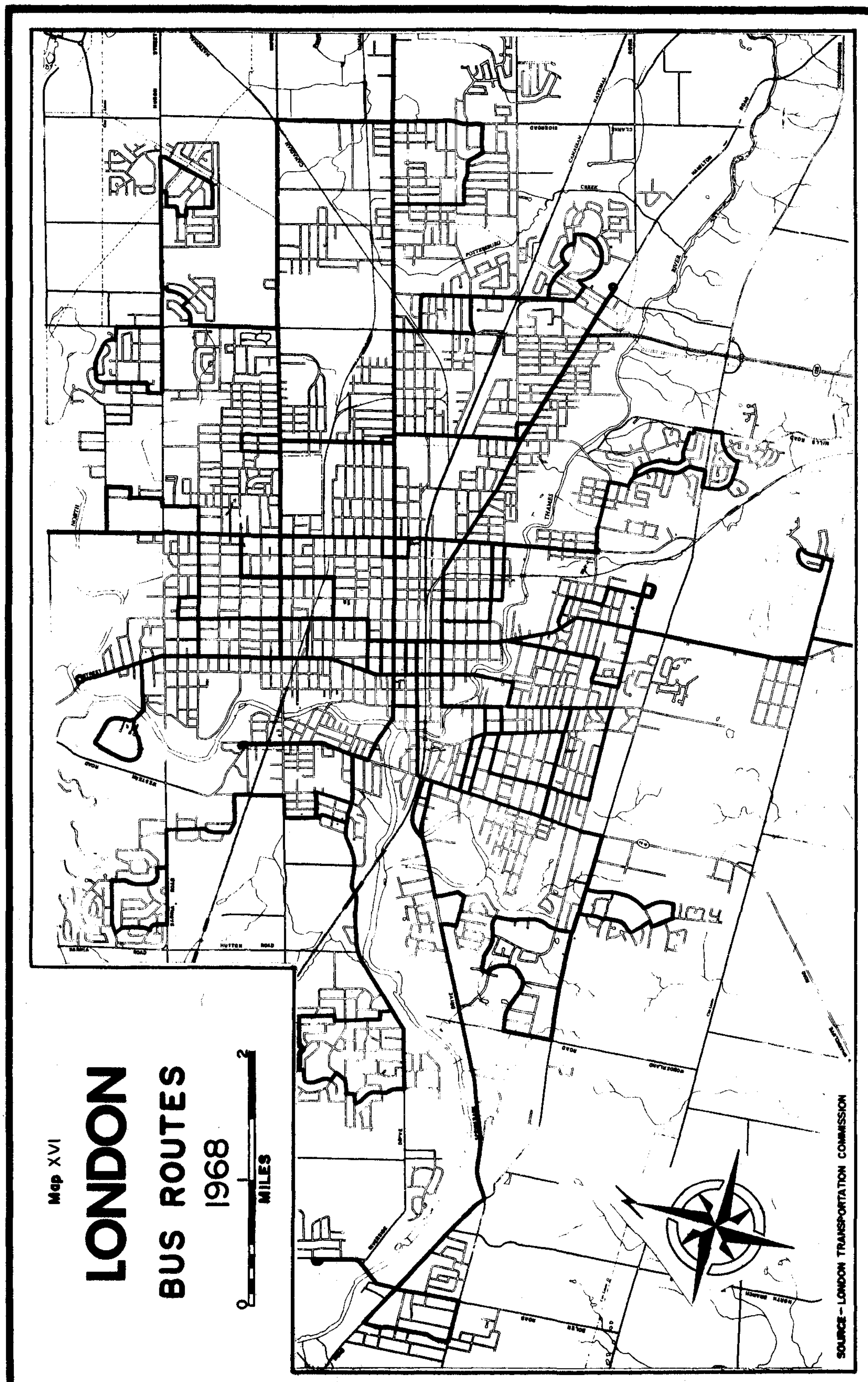
London meandering is partially due to the twisted nature of the streets. However, collecting sufficient fares was equally important, as the L.T.C. too, had been suffering from a decreasing patronage and was unable to maintain service into the suburbs at frequencies comparable with the core areas.[19]

Other changes to take place between 1950 and 1968 were, again, minor in nature and represented a filling in of the eastern regions, located within the pre-1966 boundaries of London. The addition of new connectives was more pronounced in London and the Beta Index did not decrease as it had in Windsor, (see Table 3). Although the Beta Index reflected a rise in connectivity, the rise was so small that it was insignificant. In this respect the Index tends to be misleading, as the slight increase of Beta is not a true reflection of the system's expansion in size from 40 to 95 miles. However, the increase in mileage is reflected more adequately by the network weight where large gains were experienced, resulting in additional higher order intersections, (see Table 4).

Application of the König Number

Windsor

The König Number was applied to each successive time period from 1893 to 1968. In 1893 the most central point in the network was located at the corner of Ouellette Avenue and Riverside Drive, (Graph 3). This information corresponds


Map XVI
LONDON
BUS ROUTES
1968
0
1
2
MILES
SOURCE - LONDON TRANSPORTATION COMMISSION

with historical facts which indicate that this corner was center of the original C.B.D. at the turn of the twentieth century.[20]

By 1968 the König Number indicated that centrality within the network had shifted six blocks south from the original center to the corner at Wyandotte Street and Ouellette Avenue. Although this is not the most important point within Windsor's C.B.D. in terms of shopping, it represents the main intersection in the city, as Wyandotte Street is the main crosstown artery from east to west, other than Riverside Drive and Tecumseh Road.

Suburban growth in the south is partly responsible for the migration of the C.B.D. southward from Riverside Drive. The Detroit River produced a strong barrier effect, in this instance, forcing new growth to take place in the south.[21] This fact may be substantiated with an examination of land values along Ouellette Avenue between 1893 and 1968.

Detailed examination of changing land values during the past one hundred years in the Windsor C.B.C. would have been beyond the scope of this paper, therefore, it will be sufficient to point out that land values near Riverside Drive and Ouellette Avenue, the center of the old C.B.C., have declined since 1900. On the other hand, activities with low rent paying ability, once located farther south along Ouellette Avenue, have been replaced by activities with higher rent paying ability.[22] Peak land values have migrated slowly from the Riverside Drive and Ouellette Avenue corner south to University Street and Ouellette Avenue. At the same time the Wyandotte Street and Ouellette corner is also showing strong signs of becoming the future center of peak land values.[23]

As this actual shift in land values corresponds with the changes of centrality within the public transportation network, it may be assumed that the two points are related. That is, the most central point in a public transportation network closely corresponds with the center of the C.B.D.

In addition, two nodes of high centrality in the network were noted on the 1968 graph, separated by a region of lower centrality. One node was located immediately to the south of Wyandotte Street on Ouellette Avenue; the other at the corner of Tecumseh Road and Ouellette Avenue, (Graph 8). Recent growth of apartment and office buildings, banks and stores, south of Wyandotte Street, (again, along Ouellette Avenue), is partly responsible for this phenomenon. Development of south Windsor with its shopping centers also encouraged the appearance of other nodes farther south.

London

In London similar changes in centrality occurred, but in an easterly direction along Dundas Street, (Graphs 9 to 14). Several reasons may be cited by way of explanation. First the railways passing to the north and to the south of London's C.B.D. encouraged many industries to locate in two belts on

Fig. 3

WINDSOR, 1893

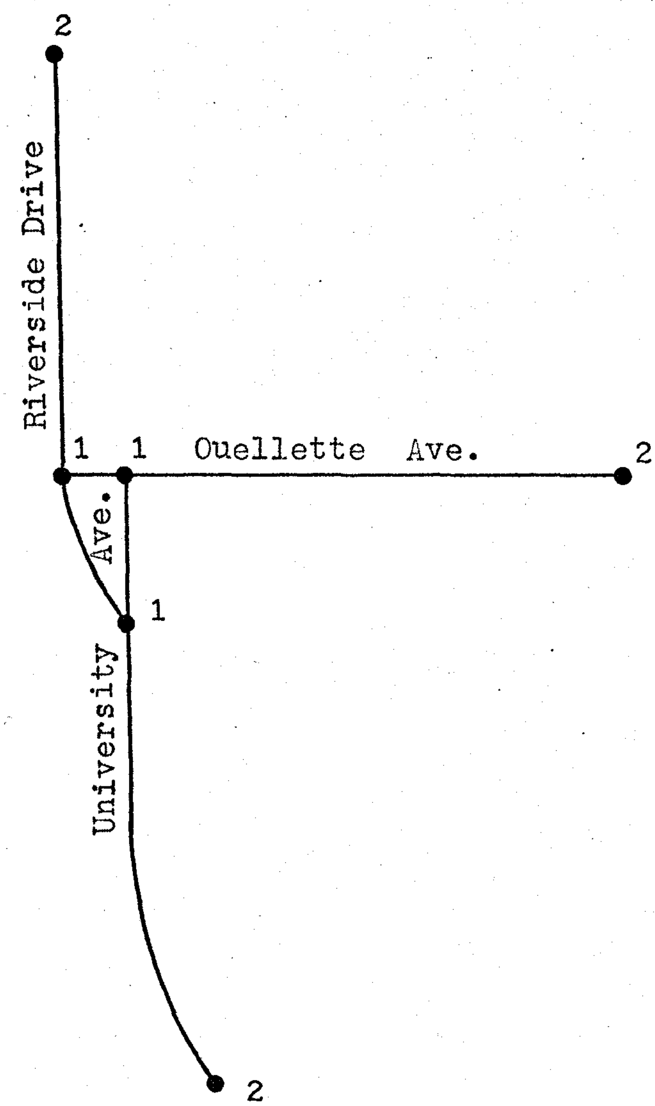


Fig. 4

WINDSOR, 1917

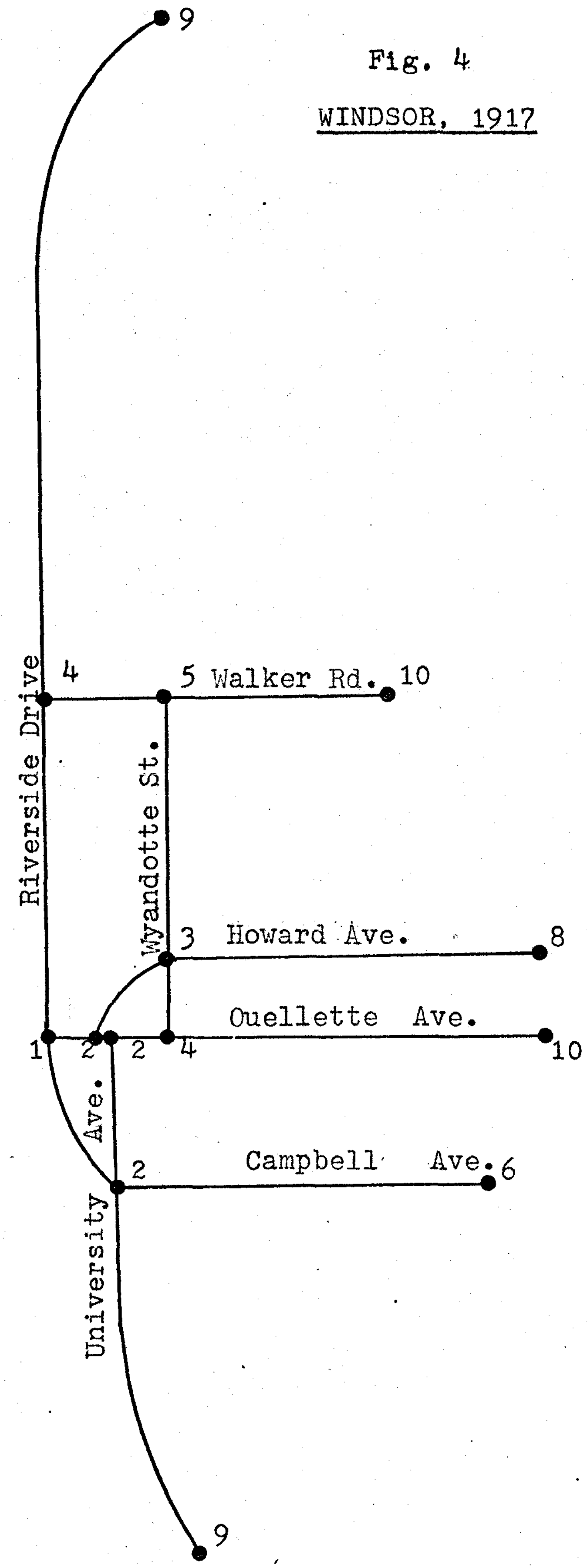


Fig. 5

WINDSOR, 1930

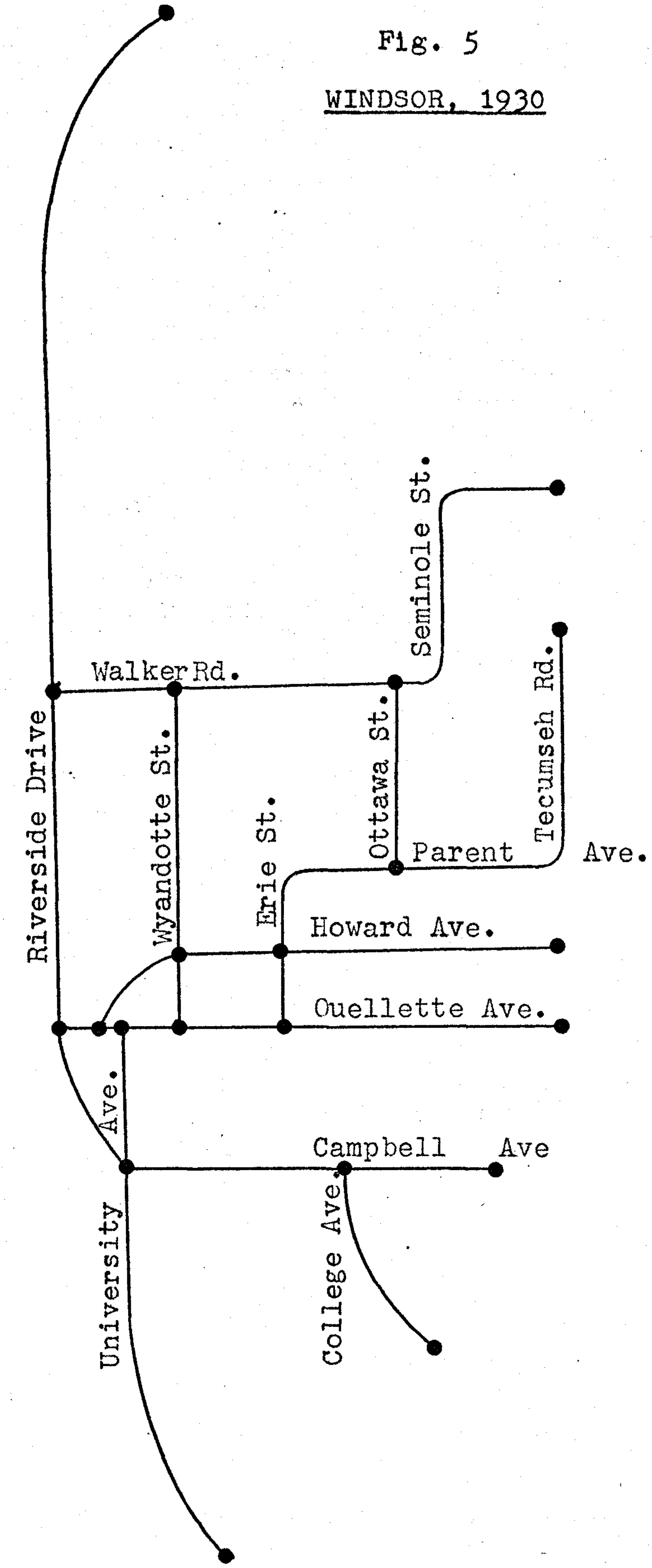


Fig. 6

WINDSOR, 1937

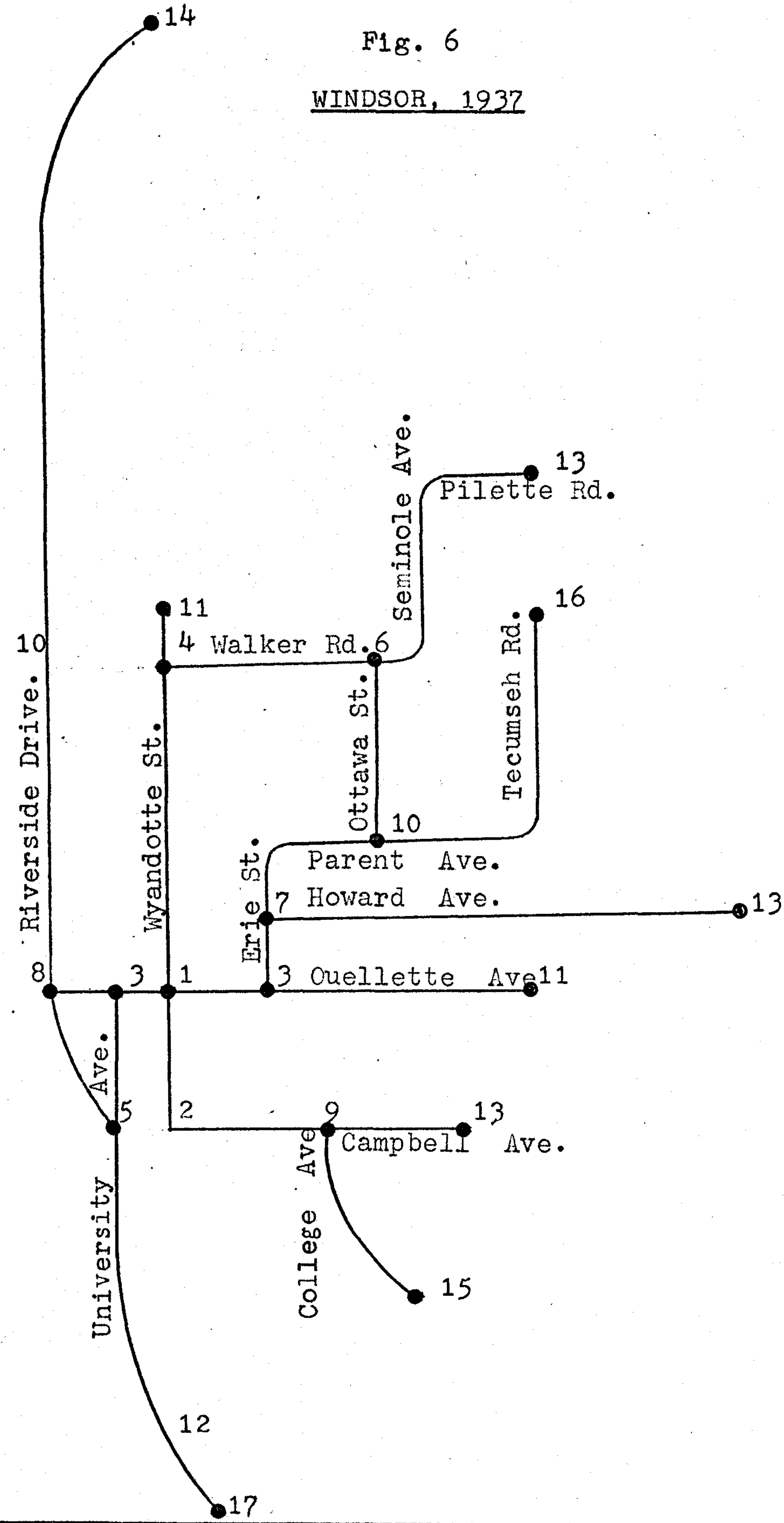


Fig. 7

WINDSOR, 1950

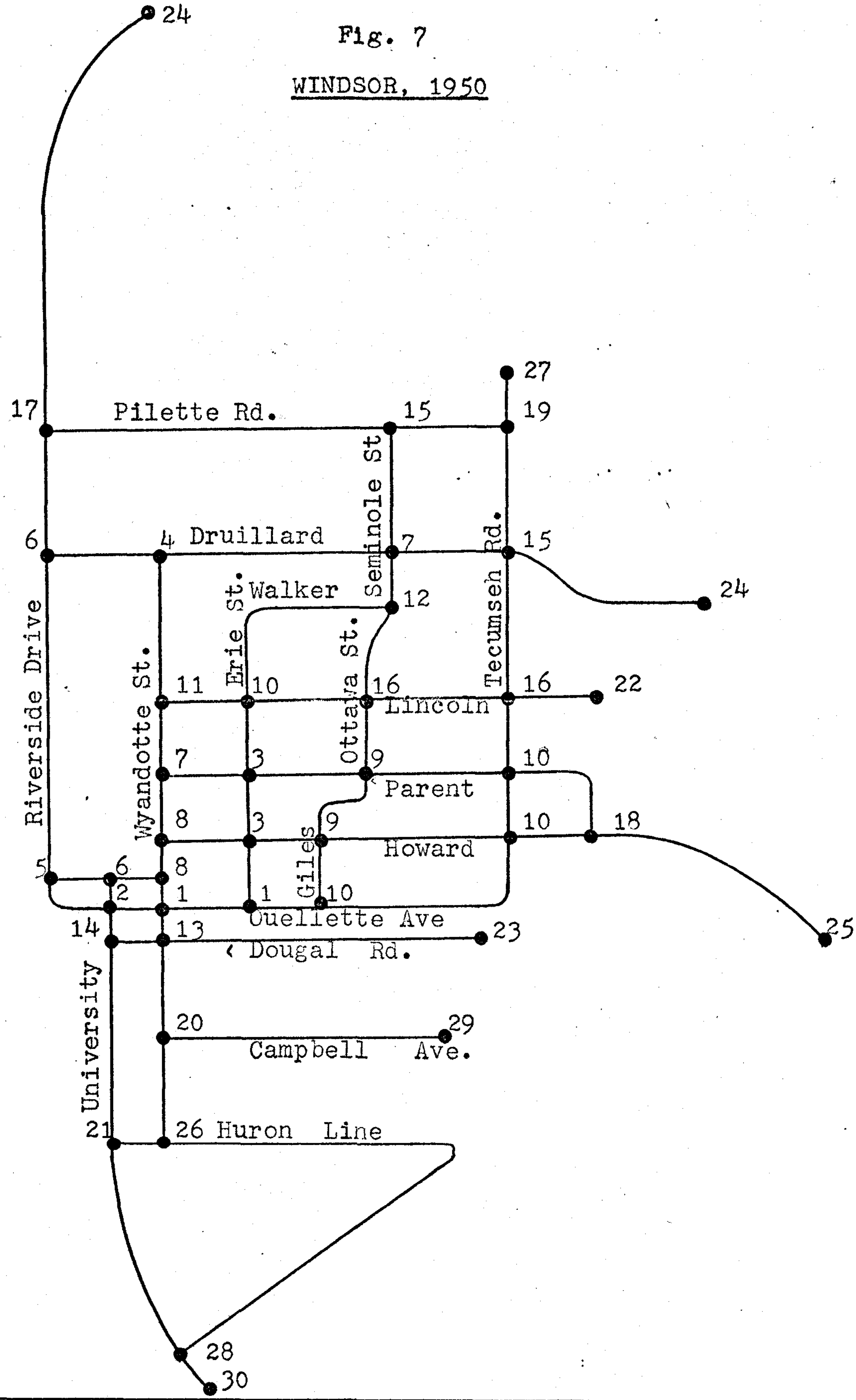
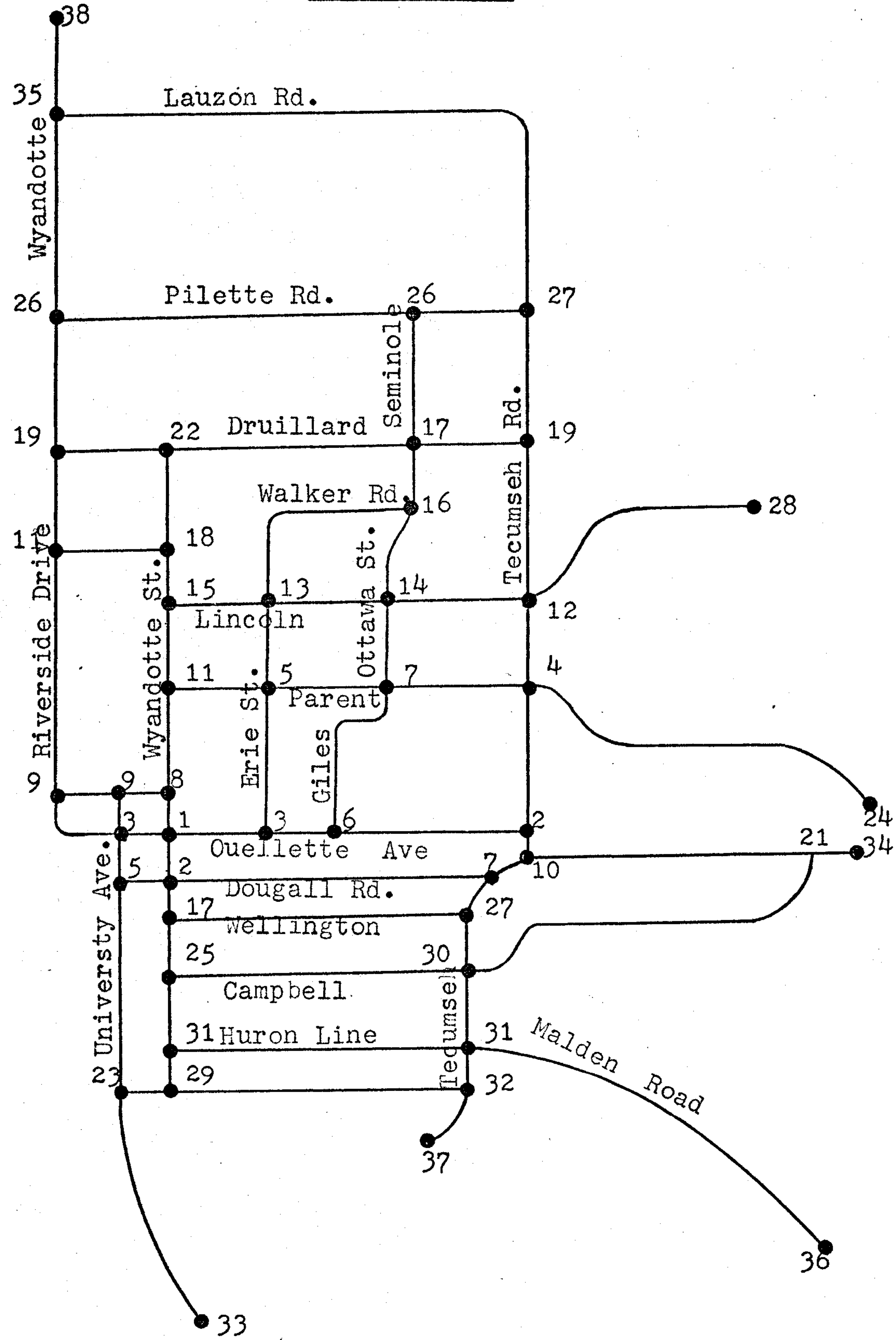


Fig. 8

WINDSOR, 1968



either side of Dundas Street, preventing commercial growth in those directions. Secondly, the Thames River, only two blocks to the west of Richmond Street, the original center of the C.B.C., provided a strong barrier. Therefore, the expansion of the C.B.C. could only progress eastward, away from Richmond Street.

A large proportion of London's residential growth up to 1950, and even later, occurred in the east. The large number of bus lines east of Richmond Street is a reflection of this growth, (Maps XI and XV). As Ouellette Avenue had been, and still is, the main artery leading into Windsor, so Dundas Street is the main artery for London. Since London's natural links with other important cities of Ontario lie to the east and to the west, it is only natural that the C.B.D. would also expand along this direction of travel, rather than at right angles to it.

In both cities the König Number was used to determine the centrality of a node or vertex in relation to the other nodes and vertices within the system, by assigning to each a corresponding value. In this manner some idea was obtained about the changes in centrality of a city's public transportation network. As the center of the network corresponds closely with the center of the C.B.D., the two points may be considered as related.[24] Therefore, some understanding about the movements of the C.B.D. may be obtained through a study of the city's public transportation network.

In Chapter I it was indicated that flow data for Windsor's bus network in 1968 would be used to determine whether such data would be significant as a corrective factor when using the König Number to measure changes in centrality. (The low frequency lines were eliminated for the purpose of this experiment). The network was anlysed without weighting of lines and the results were recorded. This was followed by an analysis of the weighted network. Weightin only served to reinforce points of high or low centrality nut did not actually change the pattern within the downtown area, (see Fig. 15 and Fig. 16).

Fig. 9

LONDON, 1893

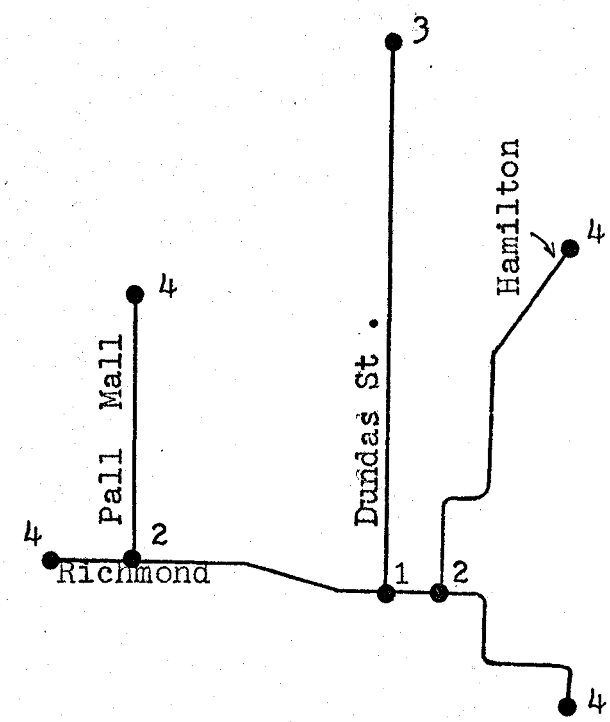


Fig. 10

LONDON, 1897

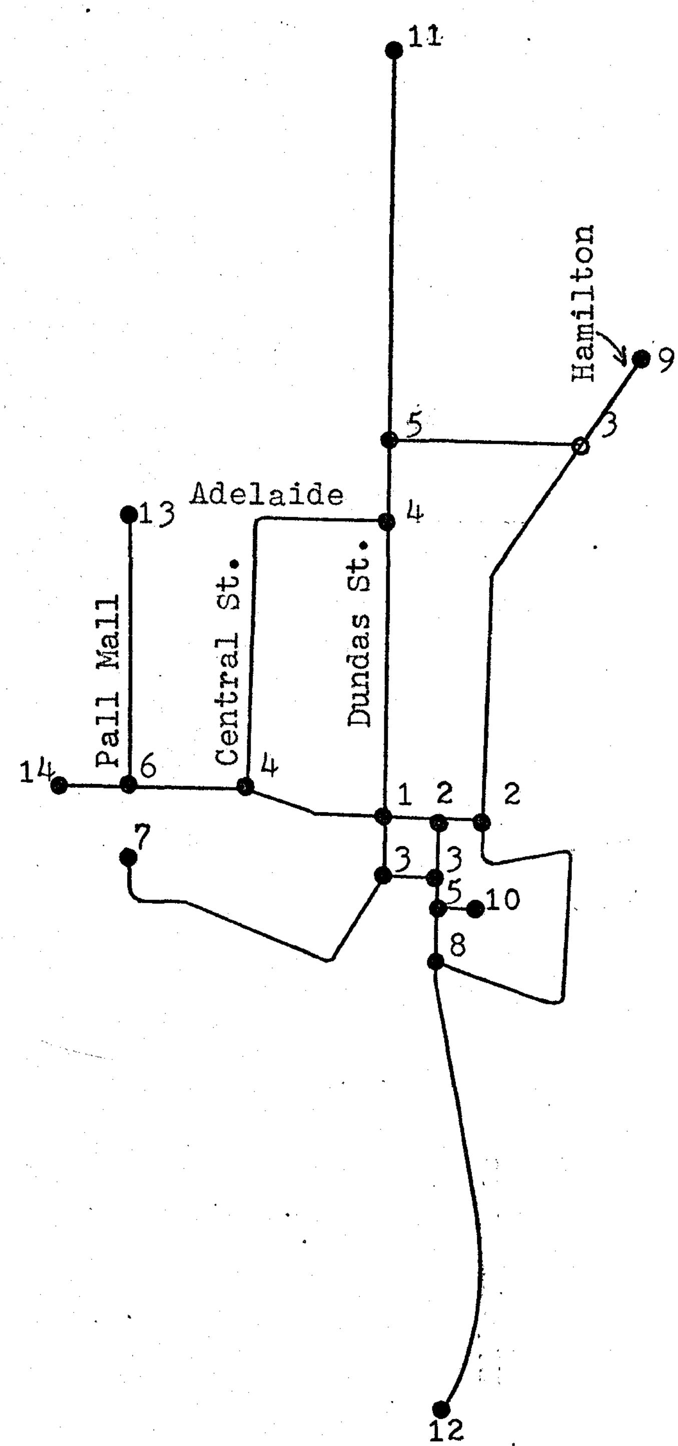


Fig. 11

LONDON, 1909

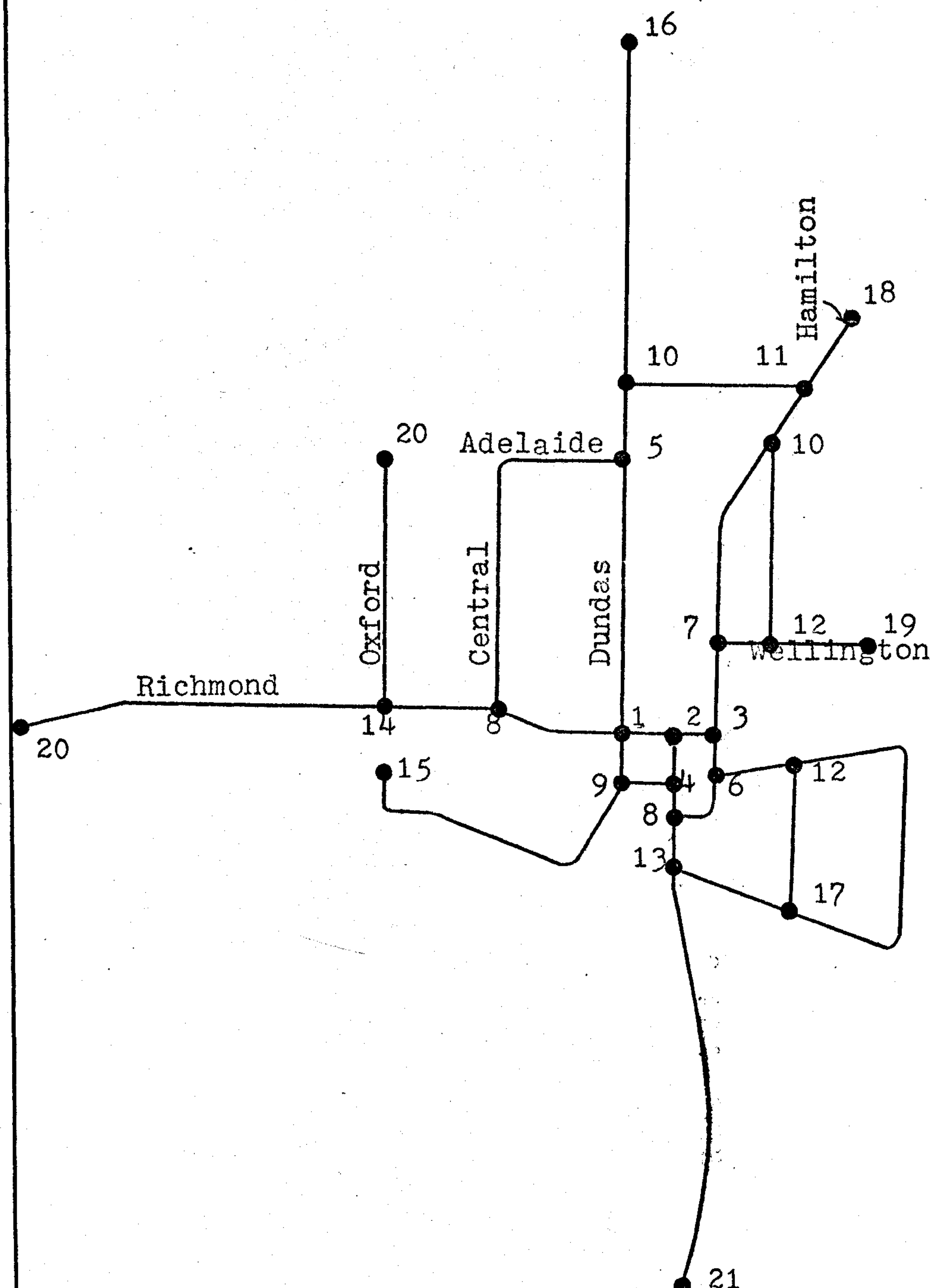


Fig. 12

LONDON, 1920 - 1937

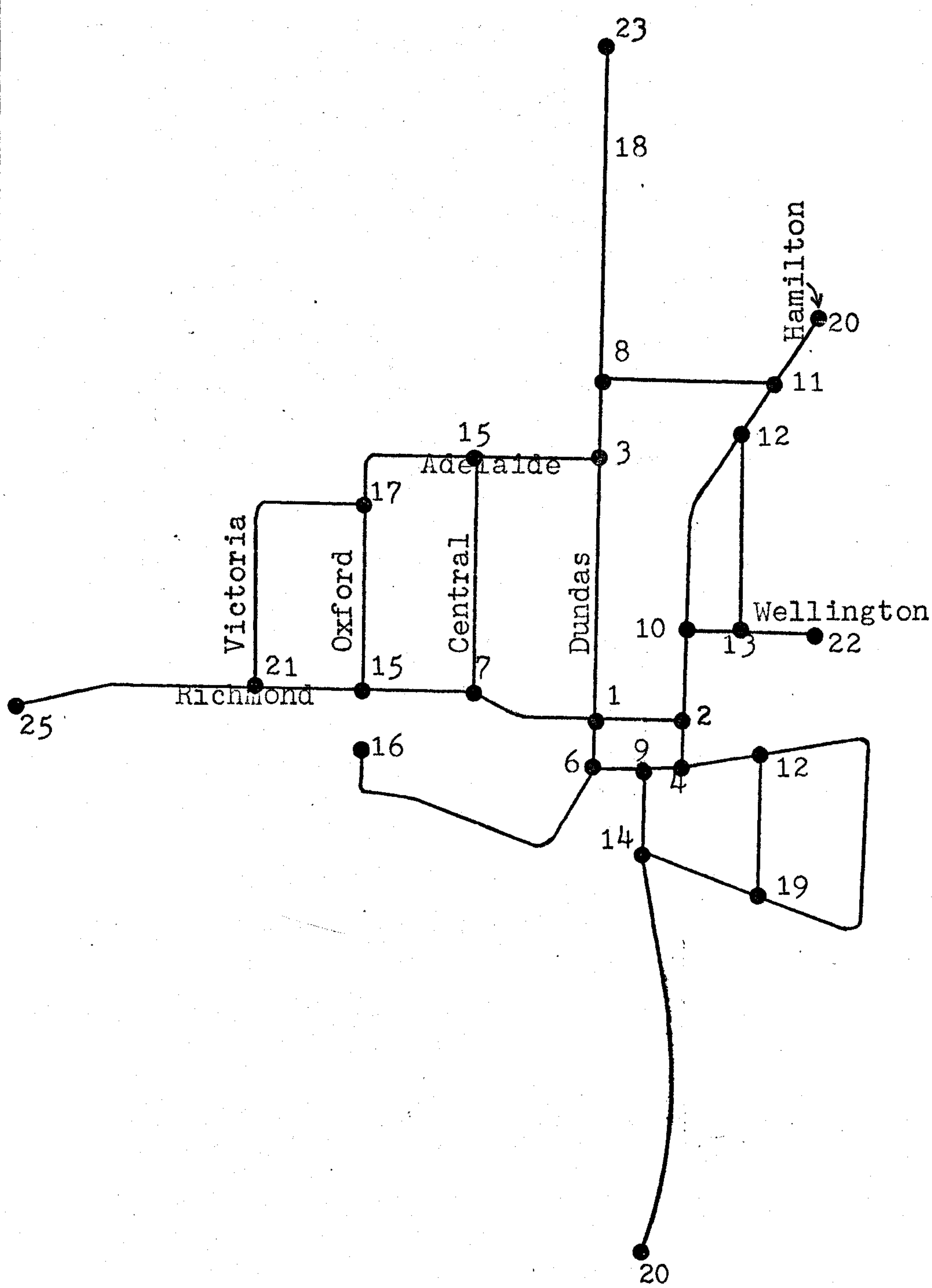
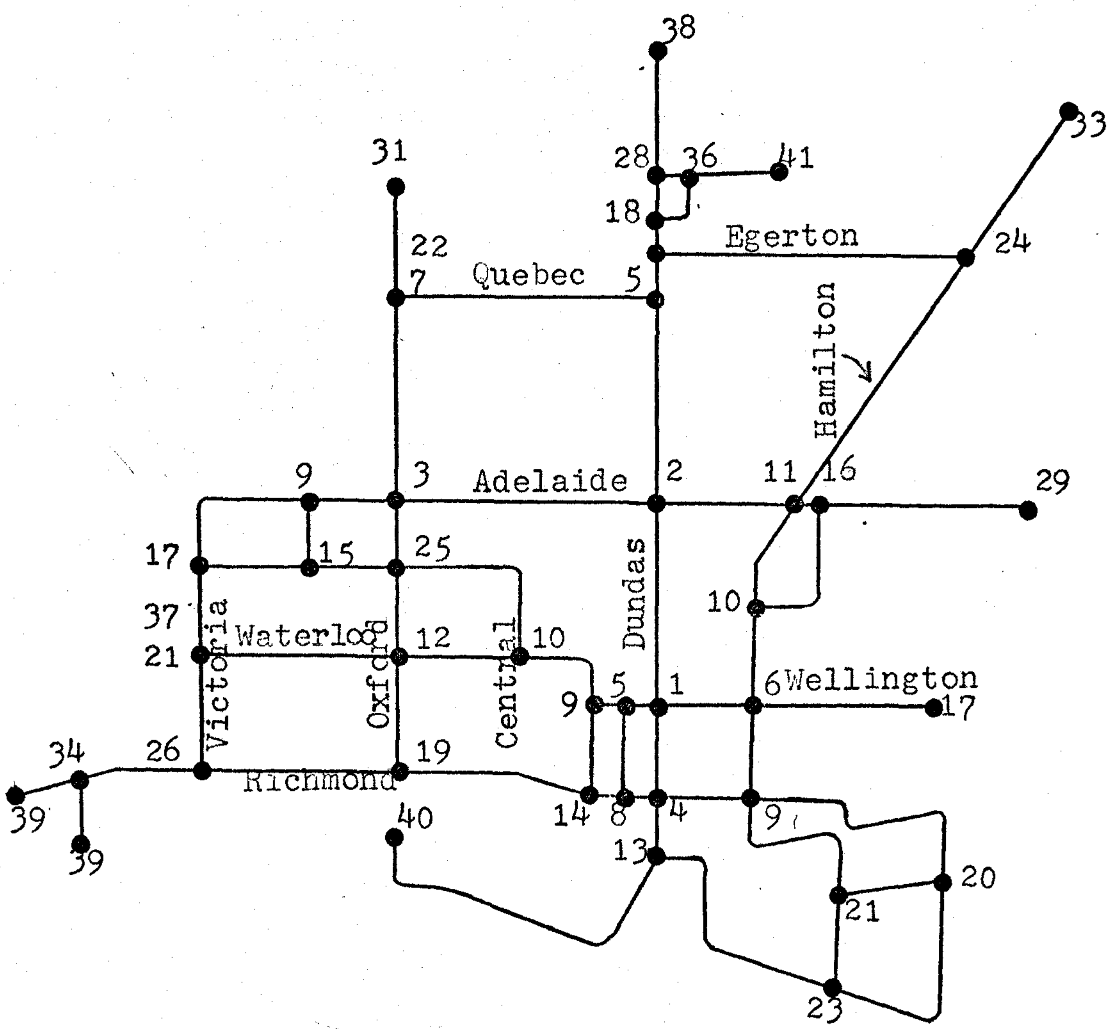


Fig. 13

LONDON, 1950



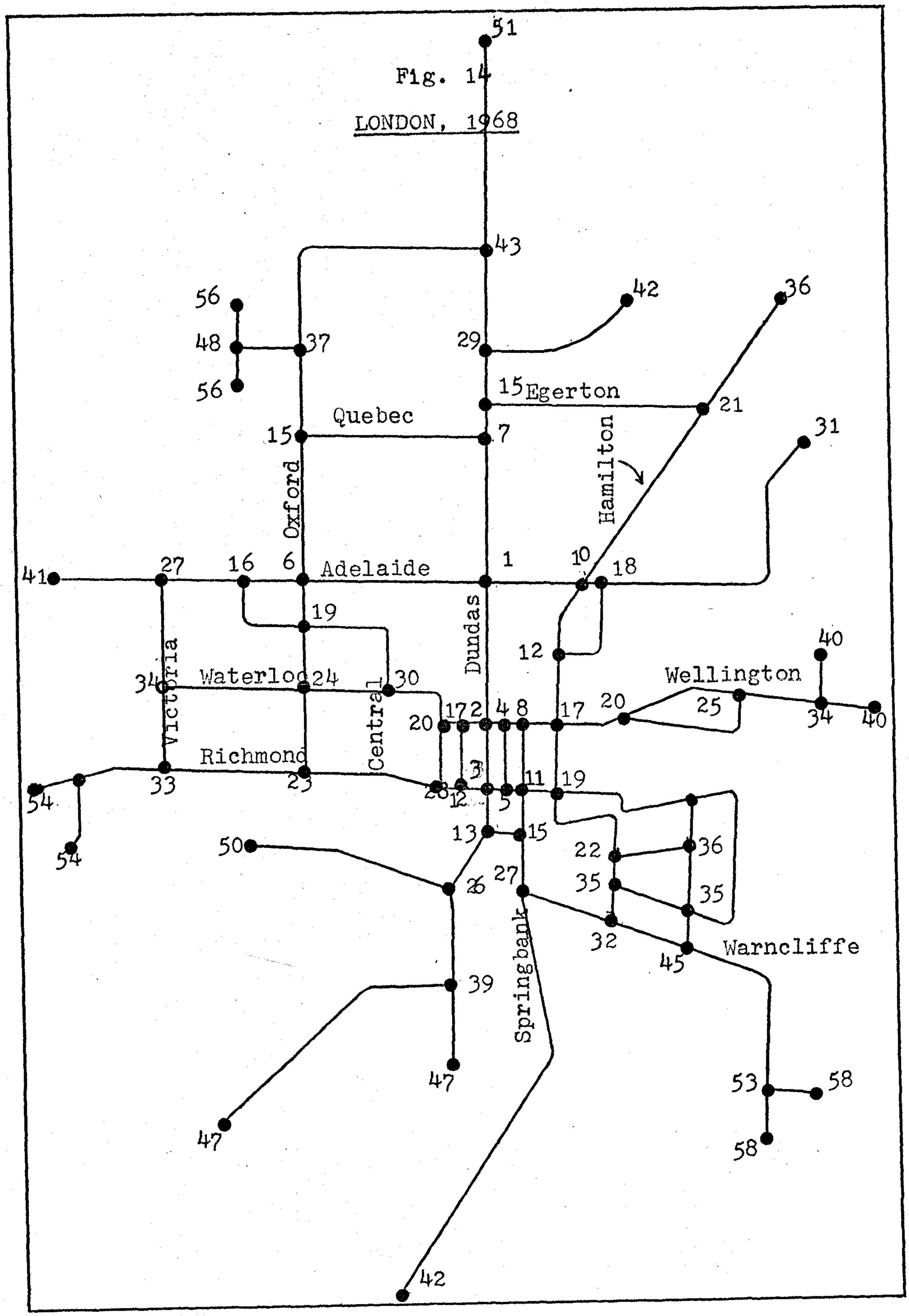


Fig. 14
LONDON, 1968

Fig. 15

WINDSOR, 1968 HIGH DENSITY ROUTES, STYLIZED

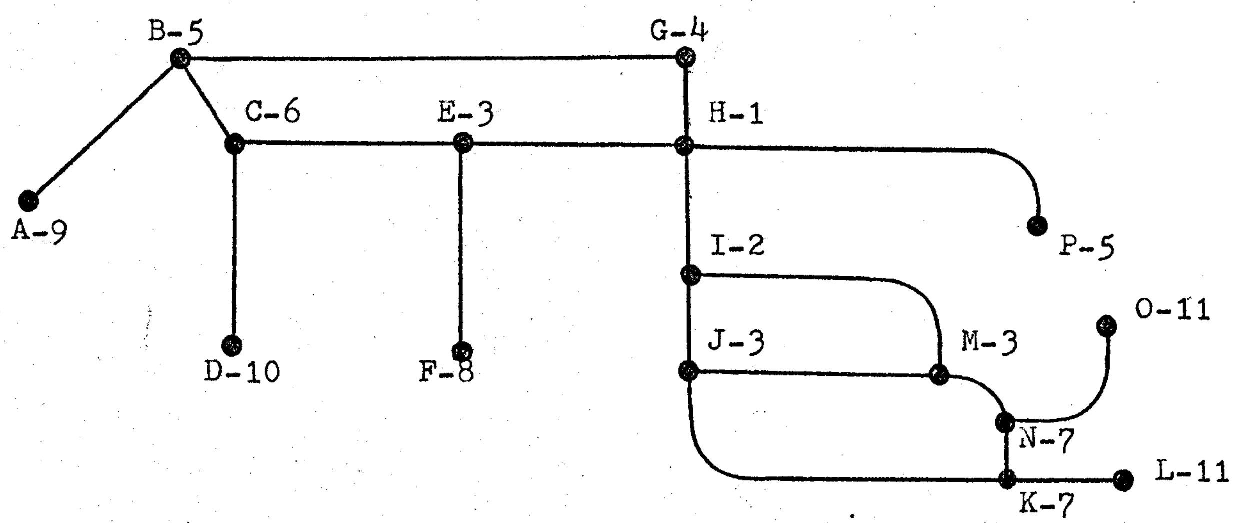
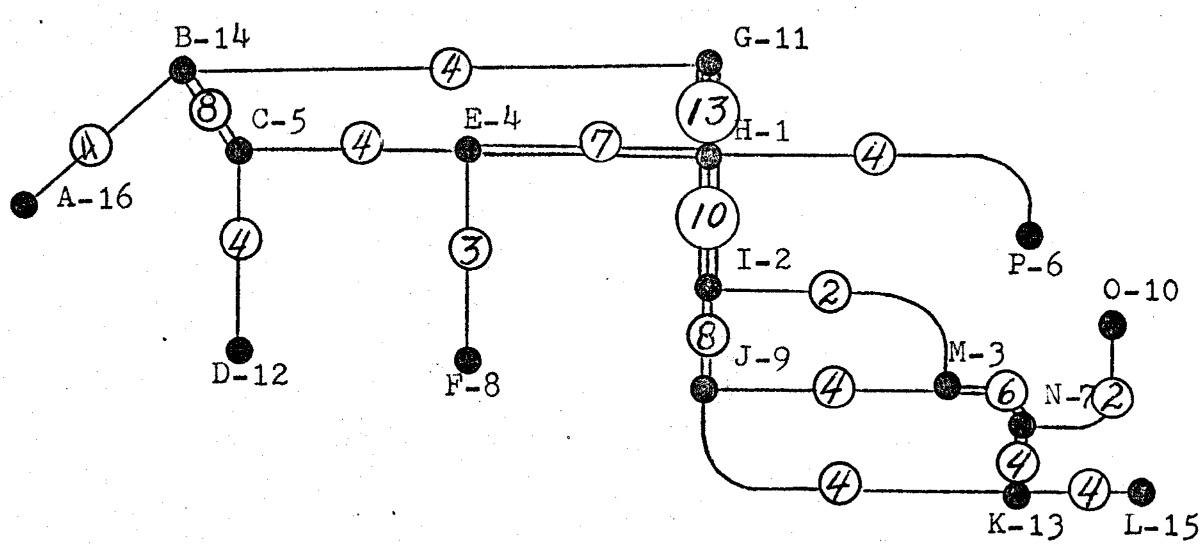


Fig. 16

WINDSOR, 1968 WEIGHTED HIGH DENSITY ROUTES, STYLIZED



CHAPTER III

NOTES

1. "Buses Substituted on 12 Lines in City", A report by W. H. Furlong, Chairman, Board of Directors, Sandwich, Windsor and Amherstburg Railway Company. Windsor Daily Star, (October 1, 1938).

2. Canada, Dominion Bureau of Statistics, Canada Year Book, 1940. (Ottawa, 1940), p. 422.

3. Canada, Dominion Bureau of Statistics, Motor Vehicle Branch, Part III, 1960 - 1967. (Ottawa, 1968).

4. "Buses Substituted on 12 Lines in City", A report by W. H. Furlong, Chairman, Board of Directors, Sandwich, Windsor and Amherstburg Railway Company. Windsor Daily Star, (October 1, 1938).

5. Ibid.

6. Interview with Mr. J. A. Norry, Research and Development Division. Sandwich, Windsor and Amherstburg Railway Company. (September, 1968).

7. Interview with Mr. N. H. Easson, Sandwich, Windsor and Amherstburg Railway Company. (January, 1971).

8. Ibid.

9. Ibid.

10. Canada, Dominion Bureau of Statistics, Census of Canada, 1941. (Ottawa, 1941),

11. Canada, Dominion Bureau of Statistics, Census of Canada, 1966. (Ottawa, 1966).

12. Ralph R. Krueger and Raymond G. Corder, Canada: A New Geography, (Toronto, 1968), p. 238.

13. Ibid., p. 238

14. Ibid., p. 238.

15. Marion Clawson, "Urban Sprawl and Speculation In Urban Land", in R. G. Putnam, F.J. Taylor, P. G. Kettle, editors, A Geography of Urban Places, (Toronto, 1970), p. 313.

16. *Ibid*., p. 313.

17. *Annual Report of the Assessment Department for the City of Windsor*, (December 31, 1968), p. 14.

18. E. G. Faludi, *Windsor's Master Plan, 1945 - 1975*, (Toronto, 1945).

19. Interview with C. K. Morningstar, Operating Superintendent, The London Transportation Commission, (January, 1971).

20. Historical documents and old photographs indicate that this particular corner was the center of the C.B.D. in Windsor during the late 1800's. There was even some mention that the area south of Wyandotte Street was considered 'out in the country'. During this time buildings, similar in appearance to the buildings standing along the south side of Riverside Drive at Ouellette Avenue, occupied the north side of Riverside Drive as well. Buildings also stood on both sides of Ouellette Avenue down to the river's edges where numerous passenger ferries docked.

21. Robert S. Yuill discusses the effects of barriers on transportation in, Robert S. Yuill, "A Simulation Study of Barrier Effects in Spatial Difussion Problems", *Discussion Paper Number 5*. Michigan Intra-University Community of Mathematical Geographers, 1964.

22. Steve Maerzluft, *The Central Business District of Windsor, A Geographic Study*. Unpublished Bachelor Thesis, Department of Geography, University of Windsor, 1968, p. 30.

23. *Ibid*., p. 30.

24. Steve Maerzluft explains that many offices and department stores which locate close to the center of the C.B.D. do so because their employees, (mostly women), must be close to bus transportation., Steve Maerzluft, *The Central Business District of Windsor, A Geographic Study*. Unpublished Bachelor Thesis, Department of Geography, University of Windsor, 1968, p. 27.

CHAPTER IV

CONCLUSION

This paper has examined the evolution of public transportation networks in Windsor and London from 1872 to 1968. The paper demonstrated that advances in technology, rather than population growth, were primarily responsible for the change in the shape and size of networks.

From the analysis of the material contained in this study the following conclusions have been drawn:

1. Public transportation networks in Windsor and London maintained an overall similarity of development, despite differences in history, topography, urban morphology and socio-economic characteristics.

2. Radical changes in the size and shape of these networks occured only after technological advances permitted the introduction of a new mode of transportation.

3. Political influences such as annexations, not population growth, have been responsible for the most recent network expansions in Windsor and London.

Advances in technology such as electricity in place of horse-drawn trams insured greater speed and dependability and widened the operating radius of mass transportation.

However, high construction and operating costs limited service to areas of high population density. In the Windsor area early streetcars connected clusters such as the city of Windsor with the towns of Sandwich and Walkerville; or downtown Windsor with the race track.

In London, streetcar lines connected the infantry barracks, for example, with the downtown; major residential areas with important industrial clusters; or the downtown with a railway depot. In both cities connecting lines were built, only along main throughfares, where commercial activity and pedestrian movement was greatest.

Networks in both cities more than trippled in size within a few years after the introduction of electricity. High costs, however, forced both network to retain the radial shape which had been established by the preceding horse-tram networks. Nevertheless, during the years of electric streetcars several interconnections were developed within both systems.

Greatest expansion of electric networks in Windsor and London occured between 1890 and 1920. After this date both networks achieved a high degree of stability and remained relatively undisturbed until the introduction of buses. During these years of stability the population of both cities increased a great deal, indicating that population growth did not exert a strong influence upon network development.

The introduction of buses in Windsor and London, characterized by greater flexibility and lower costs, resulted in a doubling of route mileage in the two cities. New lines were developed along streets of secondary importance and in areas of lower population density such as the suburbs.

Although the automobile had encouraged the appearance of lower density suburbs around Windsor and London, very little network growth had taken place in these suburbs until 1966. Most of the expansion had been confined within the city limits. In 1966 both cities acquired large portions of the surrounding suburbs through annexation. As a result, mass transit service was introduced into the suburbs as a response to a political readjustment, rather than to satisfy the demands for public transportation. Since 1966, a lack of patronage of mass transit facilities in the suburbs has encouraged the development of extensive looping and meandering of bus lines in the hope of bringing the service closer to the consummer and capturing additional fares.

Extensive use of private automobiles in place of mass transit has resulted in the loss of revenue by the Sandwich, Windsor and Amherstburg Railway Company as well as the London Transportation Commission. At the same time, the private automobile has created a host of other problems such as parking, pollution and congestion. Consequently, interest in mass transportation has been renewed, even in cities of moderate size, such as Windsor and London.

Although public transportation networks and urban structure are closely related, it is not clear to what extent one affects the other. Consequently, further research in this area would be very significant in establishing this relationship. The König, or Associated Number may become a handy tool in this research. The König Number may be used to analyse the strength and importance of connectives within a network, or it may be used as an index of centrality. When used in its latter form it can show a close relationship between the most central node in a public transportation network and the movement of the Central Business District. As the most central nodes in the networks seem to corespond with the Central Business Districts in Windsor and London, changes in the center of a network may well be used to trace the expansion of a C.B.D. in a given city through time, and to predict future growth.

BIBLIOGRAPHY

Government publications

Canada, Dominion Bureau of Statistics. Canada Year Book 1918. Ottawa: King's Printer, 1919.

Canada, Dominion Bureau of Statistics. Canada Year Book 1931. Ottawa: King's Printer, 1931.

Canada, Dominion Bureau of Statistics. Canada Year Book 1950. Ottawa: Queen's Printer, 1950.

Canada, Dominion Bureau of Statistics. Canada Year Book 1968. Ottawa: Queen's Printer, 1968.

Canada, Dominion Bureau of Statistics. Census of Canada 1890-91. Ottawa: Queen's Printer, 1894.

Canada, Dominion Bureau of Statistics. Census of Canada 1911. Ottawa: Queen's Printer, 1913.

Canada, Dominion Bureau of Statistics. Census of Canada 1931. Ottawa: King's Printer, 1932.

Canada, Dominion Bureau of Statistics. Census of Canada 1941. Ottawa: King's Printer, 1942.

Canada, Dominion Bureau of Statistics. Census of Canada 1966. Ottawa: Queen's Printer, 1966.

Canada, Dominion Bureau of Statistics. Motor Vehicle Branch, Part III, 1960-1967. Ottawa: Queen's Printer, 1968.

Books

Chorley, Richard, J. and Peter Haggett. Socio-Economic Models in Geography. London: Methuen and Co. Ltd. 1967.

Cole, John, P. and Cuchilaine, A. M. King. Quantitative Geography. London: John Wiley and Sons, Ltd., 1968.

Cullen, Gordon. Townscape. London: Architectural Press, 1967.

Daggett, Stewart. Principles of Inland Transportation. New York: Harper and Brothers, 1943.

Essex County Historical Association. Essex County Radio Sketches.

Gallion, Arthur, B. The Urban Pattern: City Planning and Design. New York: Van Nostrand, 1962.

Glaab, Charles, N. The American City. Homewood: The Dorsey Press, Inc., 1963.

Glazebrook, G. P. T. A History of Transportation in Canada. Toronto: The Ryerson Press, 1938.

Haggett, Peter. Locational Analysis in Human Geography. London: Arnold Publishers, Ltd., 1967.

Haggett, Peter and Richard J. Chorley. Network Analysis in Geography. London: Edward Arnold Publishers, Ltd., 1969.

Johnson, James, H. Urban Geography. Oxford: Pargamon, 1967.

Kansky, K. J. Structure of Transportation Networks: Relationship Between Network Geometry and Regional Characteristics. Chicago: University of Chicago Press, 1963.

Krueger, Ralph, R. and Raymond G. Corder. Canada: A New Geography. Toronto: Holt, Rinehart and Winston, Limited, 1968.

Lajeunesse, Ernest, J. The Windsor Border Region. Toronto: The Champlain Society, 1960.

Massman, Frank, H. Principles of Transportation. New York: The Ronald Press Company, 1957.

Morrison, Neal, F. Garden Gateway to Canada. Toronto: The Ryerson Press, 1954.

Murphey, Raymond, E. The American City. New York: Mc Graw-Hill, Inc., 1966.

Neal, Fredrick. The Township of Sandwich. Windsor: The Record Printing Company, Limited, 1909.

Smerk, George, M. Urban Transportation: The Federal Role. Bloomington: Indiana University Press, 1965.

Vernon, R. Metropolis, 1985. New York: Doubleday and Company, Inc., 1959.

Weaver, Robert, C. The Urban Complex. New York: Doubleday and Company, Inc., 1966.

Wentworth, Eldridge, H., ed. Taming Megalopolis. Garden City: Doubleday and Company, Inc., 1967.

Yeates, Maurice, H. An Introduction to Quantitative Analysis in Economic Geography. New York: McGraw-Hill Book Company, 1968.

Urban Studies

Department of Highways and the Corporation of the City of Windsor. A functional Report for the E.C. Row Expressway. Toronto: M. M. Dillon, Limited, 1967.

Faludi, E. G. A Master Plan for the Development of the City of Hamilton. City Planning Committee of Hamilton, 1947.

Faludi, E. G. and Associates. A Fifteen Year Programme for the Urban Renewal of the City of Windsor and its Metropolitan Area. Toronto: 1959.

Faludi, E. G. Windsor's Master Plan 1945-1975. Toronto: 1945.

Guard, Donald and Gordon Stephenson. Urban Renewal, London: A Plan for Redevelopment. London: 1960.

Jones, Murray, V. and Associates. London Urban Renewal Study. London: 1966.

Jones, Murray, V. and Associates. Central London Urban Renewal Scheme. Toronto: 1967.

Margison, A. D. and Associates. London Area Traffic Plan, 1959-1980. London: 1960.

Margison, A. D. and Associates. Traffic Planning Study; Report. London: 1966.

Department of Highways Planning Branch. London Area Highway Planning Study. Toronto: 1966.

Windsor Area Transportation Study. Toronto: M. M. Dillon and Company, Limited, 1963.

Articles

Alfonso, William. "The Historical and Structural Theories of Urban Form: Their Implication for Urban Renewal". Land Economics. Vol. 40, (1960), pp. 227-231.

Beckman, Martin. "Principles of Optimum Location for Transportation Networks", in W. L. Garrison and D. F. Marble, editors. Quantitative Geography, Part I: Economic and Cultural Topics. Evanston: Northwestern University, 1967.

Berry, Brian, J. L. "Cities as Systems within Systems of Cities". The Regional Science Association. Vol. 13, (1964), pp. 147-163.

Bunge, William. "Patterns of Location". Discussion Paper Number 3. Michigan Inter-University Community of Mathematical Geographers, 1964.

Bunge, William. Theoretical Geography. Lund Studies in Geography, Series c, General and Mathematical Geography I, 1962.

Burton, Ian. Accessibility in Northern Ontario: An application of Graph Theory to a Regional Highway Network. (1962), pp. 1-25.

Casetti, Emilio. "Urban Population Denisty Patterns: An Alterhate Explanation". Canadaian Geographer. Vol. II, No. 2, (1967), pp. 96-100.

Chorley, Richard, J. "Geography and Analog Theory", in Brian J. L. Barry and Duane F. Marble. Spatial Analysis. Englewood Cliffs: Prentice-Hall, Inc., 1968.

Clawson, Marion. "Urban Sp awl and Speculation in Urban Land", in R. G. Putnam, F. J. Taylor and P. G. Kettle, editors. A Geography of Urban Places. Toronto: Methuen, 1970.

Garrison, William, L. "Connectivity of the Interstate Highway System". Paper and Proceedings. Regional Science Association, VI, (1960), pp. 122-137.

Garrison, William, L. "Studies of Highway Development and Geographic Change". University of Washington Press, 1960.

Katz, Leo. "A New Status Index Derived from Sociometric Analysis". Psychometrica. 18, (1953), pp. 39-40.

Marble, Duane, F. "A Theoretical Explanation of Individual Behavior", in W. L. Garrison and Duane F. Marble, editors. Quantitative Geography, Part I: Economic and Cultural Topics. Evansotn: Northwestern University Press, 1967.

Mayer, Harold, M. "Urban Geography". American Geography: Inventory and Prospect. Syracuse: Syracuse University Press, 1954.

Morrill, Richard, J. "The Movement of Persons and the Transportation Problem", in W. L. Garrison and Duane F. Marble, editors. Quantitative Geography, Part I: Economic and Cultural Topics. Evanston: Northwestern University, 1967.

Nystuen, John, D. "A Theory and Simulation in Intra-Urban Travel", in W. L. Garrison and Duane F. Marble, editors. Quantitative Geography, Part I: Economic and Cultural Topics. Evanston: Northwestern University, 1967.

Nystuen, John, D. "Identification of Some Fundamental Spatial Concepts", in Brian, J. L. Barry and Duane F. Marble. Spatial Analysis. Englewood Cliffs: Prentice Hall, Inc., 1968.

Nystuen, John, D. and Michael F. Dacey. "A Graph Theory Interpretation of Nodal Regions". Papers and Proceedings. Regional Science Association, VII, (1961), pp. 29-42.

Pitts, Forest, R. "A Graph Theoretic Approach to Historical Geography". The Professional Geographer. Vol. XVII, No. 5, (Sept. 1965), pp. 15-20.

Shimbel, Alfonso. "Application of Matrix Algebra to Communications Nets". Bulletin of Mathematical Biophysics. Vol. 13, (1951), pp. 165-178.

Smerk, George, M. Urban Transportation: The Federal Role. Bloomington: Indiana University Press, 1965.

Ullman, Edward, L. "Transportation Geography". American Geography: Inventory and Prospect. Syracuse: Syracuse University Press, 1954.

Walmsley, Mildred, M. "The Bygone Electric Inter-Urban System". The Professional Geographer. Vol. XVII, (May 1965), pp. 1-5.

Ward, David. "Comparative Historical Geography of Streetcar Suburbs in Boston, Massachusetts and Leeds, England: 1850 to 1920". Annals of the Association of American Geographers. Vol. 54, (December 1964), pp. 477-489.

Warntz, William. "Macroscopic Analysis and Some Patterns of the Geographical Distribution of Population in the United States, 1790-1950", in W. L. Garrison and Duane F. Marble, Editors. Quantitative Geography, Part I: Economic and Cultural Topics. Evanston: Northwestern University, 1967.

Wilson, Norman, D. "Some Problems of Urban Transportation". Essays In Transportation. Toronto: University of Toronto Press, 1941.

Yuill, Robert, S. "A Simulation Study of Barrier Effects in Spatial Diffusion Problems". Discussion Paper Number 5. Michigan Intra-University Community of Mathematical Geographers, 1964.

Newspaper Articles

Furlong, W. H., Chairman, Board of Directors, Sandwich, Windsor and Amerstburg Railway Company. "Buses Substituted on 12 Lines of City". Windsor Daily Star. (October 1), 1938.

MacPherson, H. L. "The Rise and Fall of Area's W.E. & L.S.". Windsor Dail Star. (Dec. 24), 1965.

Neal, Fredrick. "Sandwich, Past and Present". The Evening Record. (May 23), 1917.

MacDonald Historical Collection. Hiram Walker Historical Museum. Unit 20-135-5.

MacDonald Historical Collection. Hiram Walker Historical Museum. Unit 20-135-40.

"Stage Coach to Motor Bus". Windsor Daily Star. (August 1), 1942.

"Windsor History". Windsor Daily Star. Centenial Supplement. (August 14), 1954.

Interviews

Easson, N. H., Sandwich, Windsor and Amherstburg Railway Company. January, 1971.

Farthing, H. A., Director of Research. The Hamilton Street Railway Company. September, 1968.

Morningstar, C. K. Operating Superintendent. The London Transportation Commission. September, 1968.and January 1971.

Norry, J. A. Research and Development Division. Sandwich Windsor and Amherstburg Railway Company. October, 1967 and September, 1968.

Reitzel, Neil. Operating Superintendent. Public Utilities Commission of Kitchener. September, 1968.

Miscellaneous

Annual Report of the Assessment Department for the City of Windsor. (December 31, 1968).

Canadian Federation of Mayors. 1st Canadian Urban Transportation Conference, Proceedings. Calgary: 1970.

Maerzluft, Steve. The Central Business District of Windsor, A Geographic Study. Unpublished Bachelor Thesis, Department of Geography, University of Windsor, 1968.

VITA

Born August 30, 1940.

Emigrated to Canada, 1950,

Served three years in the Second Battalion, Princess Patricia's Canadian Light Infantry, 1959 to 1962,

Graduated from Assumption Highschool, 1964,

Married Evelyn Joyce Debrecen, 1965,

Father of two children, Lori Beth and Kelly Ann,

Graduated from the University of Windsor with a B. A. in Geography, 1967,

Professional experience, two years secondary school teaching.