TEMPORAL CHANGES IN CENTRALITY

TEMPORAL CHANGES IN CENTRALITY OF

SMALL URBAN PLACES

By

BARRY WILLIAM DAVY, B.A.

A Thesis

Submitted to the Faculty of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Master of Arts

McMaster University

May 1970

MASTER OF ARTS (1969)          McMASTER UNIVERSITY
(Geography)                  Hamilton, Ontario

TITLE:     Temporal Changes in Centrality of Small Urban Places

AUTHOR:    Barry William Davy, B.A.    (McMaster University)

SUPERVISOR:   Mr. D. L. Anderson

NUMBER OF PAGES:   v,   102

SCOPE AND CONTENTS:

       Under the very general topic of an historical or temporal
central place study, one particular approach to analyzing the
centrality of urban places is outlined. Centrality is taken in a
very limited context - the influence of an urban place over its
umland. The relationship between population of an urban place and
number of "labour units", or central labour units, is used to
measure the relative centrality for a sample of places. "Labour
units" themselves are introduced to denote all persons working in
central activities in an urban place. The study is carried out in
Kent and Lambton counties in Southwestern Ontario using data obtained
from the available national, provincial and county directories. Rather
than limit the study to one point in time, as most earlier works have,
an analysis is carried out through time, from 1851 to 1857. 1907 Small
urban places are the focus of attention in this study because of data
availability and accuracy. Results show a noticeable decline in
centrality over time, which is more marked in the later years.
General trends are also drawn for changes in centrality in individual
towns of differing and similar sizes. Some of the problems and short-
comings of the study are outlined as a guide to further research.

ACKNOWLEDGEMENTS

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# INTRODUCTION

> "If everything occurred at the same time
> there would be no development. If every-
> thing existed in the same place, there
> could be no peculiarity. Only space makes
> possible the particular, which then unfolds
> in time."
>                 August Lösch "Epilogue on Space"[1]

Geographers have long been interested in the relationships of town and country. One particular aspect of this relationship is the pull which an urban centre exerts on its surrounding umland. This umland includes a rural area which we normally envisage surrounding any settlement (with its complementary and reciprocal ties to the urban centre), but also includes other "lower order" places which are likewise dependent on this urban centre. The relative importance of these lower order and higher order urban centres has now generally been expressed in terms of the centrality of a place.

However, urban growth occurs over time.[2] The centrality of a point would therefore be expected to show some changes over time. Yet, by studying a variety of different size centres at one point in time, (a horizontal spatial dimension) many authors[3] have implied that similar

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[1] August Lösch, "Epilogue on Space", The Economics of Location, (New York: John Wiley and Sons, reprinted 1967), p. 508.

[2] Semple has reviewed this relationship of urban growth process and central place theory, Robert Keith Semple, "A Quantitative Separation and Analysis of Spatial Trends in the Viability of Small Urban Centres in Southern Ontario", unpublished M.A. thesis, University of Toronto, 1966; and R. L. Morrill has best illustrated this relationship in simulating settlement and growth patterns in light of some central place notions, Richard L. Morrill, Migration and the Spread and Growth of Urban Settlement, (Lund: Gleerup Publishers, 1965).

[3] H. A. Stafford Jr., "The Functional Bases of Small Towns", Economic Geography, 39 (1963), pp. 165-175.

changes will occur likewise through a vertical time dimension. The changes from small to large centres at one point in time may resemble those changes through time, but such conclusions are unfounded without a more complete observation of the temporal changes in central place theory.

The need for such a time dimension has been recognized by many authors in the past. Marshall studies the changes in the hierarchy of small urban centres at two distant points in time in Bruce and Grey counties, Ontario.[4] He later emphasizes the need to introduce the time dimension into central place research with "comparative cross-sectional studies of the same area at several different points in time".[5] Burton[6] and Janelle[7] have likewise advocated this time dimension, the latter, suggesting a "convergence rate" (from the velocity notions in Physics) to reflect improvements made in transportation as they would affect the central place structure. Of even greater significance is the recent work of Mark and Schwirian[8] who tie in the central place function and community population growth relationship, to the ecological development

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[4]John U. Marshall, "Central Places in the Queen's Bush: A Study of Service Centres and their Evolution in Bruce and Grey Counties, Ontario", unpublished M.A. thesis, University of Minnesota, (1964).

[5]John U. Marshall, "An Approach to the Analysis of Central Place Systems", unpublished Ph.D., University of Toronto, 1968, p. 297. See also R. L. Morrill, "The Development of Spatial Distributions of Towns in Sweden: An Historical Predictive Approach", Annals of the Association of American Geographers, 53 (1963).

[6]Ian Burton, "A Restatement of the Dispersed City Hypothesis", Annals of the Association of American Geographers, 53 (1963), pp. 285-9.

[7]D. G. Janelle, "Central Place Development in a Time-Space Framework", Professional Geographer, 20 (1968), pp. 5-10.

[8]Harold Mark and Kent P. Schwirian, "Ecological Position, Urban Central Place Function, and Community Population Growth", American Journal of Sociology, 73 (1967), pp. 30-41.

of regions through agricultural settlement, industrialization and metropolitanization.

The purpose of this research is therefore to investigate centrality as measured by the proportion of the population coming from outside the urban place to support its economic activities. The study is limited to small urban places for reasons of ease of data collection and resultant accuracy.

Many approaches have been suggested for describing this centrality. An attempt is made to clarify some of the terminology used in the literature and a summary of many author's findings is given.

To observe these changes in centrality, a study area of Kent and Lambton counties in Southwestern Ontario was chosen. Data on the population and "labour units", a new term which was necessarily coined to approximate a "weighted functional unit", were then collected from historical directories for all places within the confines of the two counties. The choice of time intervals as set out in chapter three was largely dependent on the availability of these historical directories. Then a final universe of all places for which data are available at each or any chosen time period was compiled and is found in appendix II. A necessary by-product of such a study included the changes in place names that occurred during the time under study (1846-1907) and these are given in appendix I.

The form and nature of the data is described in greater detail in chapter four as regards its validity, the use of labour units rather than functions, functional units or establishments, the exclusion of some activities, and any problems encountered.

In chapter five, using simple correlation and regression techniques, population (the independent variable) and labour units (the dependent variable) were then statistically analyzed as to the strength of their relationship, and the increase in labour units with each unit increment of population. Selected places in different "size classes" were also analyzed on a time series scale, plotting the ratio of population to labour units against a continuous time function. The results of the above correlation and regression analyses are then interpreted in light of earlier studies.

In the final chapter, the chief findings of this study are summarized. But even more important, some additional points of study, as revealed by this work, are raised for future investigation.

CHAPTER I

RELATIVE IMPORTANCE OF URBAN PLACES

From the earliest stages of urban development, some settle-
ments have dominated others. This dominance is often due to physical
causes such as ports, river-crossings or confluences, and mountain
passes, or more often of man-imposed military or political superiority.
Either way, this dominance is usually transformed into economic super-
iority. Therefore, one urban place tends to be relatively more important
than those around it at one specified point in time.

Urban historians also trace the development of specific urban
settlements through time, rather than relative to other settlements
at one point in time. They use terms like, "young, growing village",
"flourishing town" or "mature, thriving city" to describe changes in
an urban place through time.

Yet, these commonplace descriptive terms of many places at one
point in time, or of one place developing through time, offer little
factual comparison because of inconsistent and vague terminology used
by different authors. Some measure of the importance of urban places
is required.

Several attempts at such an index have been developed, dating
back to the works of rural sociologists like C. J. Galpin and John H.
Kolb.[1] They base a town's importance on the number and size of its

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[1]C. J. Galpin, "The Social Anatomy of an Agricultural Community",
University of Wisconsin Agricultural Experimental Station, Research
Bulletin No. 34, May 1915 and John H. Kolb, "Service Relations of Town
and Country", University of Wisconsin Agricultural Experimental Station,
Research Bulletin No. 58, Dec. 1923.

service relations with the surrounding country.

Independent of these early beginnings in American rural sociology, German geographers, headed by Walter Christaller, laid down the theoretical grounds for what geographers now call "central place theory". Basic to this entire theory is the notion that "the chief profession of a town or settlement is to be the centre of a region."[2] While Christaller's original meaning of "region" has best been translated as "complementary region", terms such as umland, hinterland (in the case of ports), tributary area and trade area have all been used to describe this "region" in different contexts. "Complementary region" was specifically chosen to stress the town and country reciprocal dependence, thus minimizing those relationships with other smaller towns and villages within its region. To emphasize this importance of a centre relative to other centres and its pull on its region, the notion of centrality has been developed within central place theory. To say that centre A has greater centrality than centre B, infers that it has greater relative importance or size in terms of its chief profession -- to be a centre of a region.

Centrality has been measured quantitatively using many different indices, each covering a different aspect, or predicting results more accurately than those before them. Planners have seen an index of centrality as a new tool for measuring the relative importance or functional status of service centres and are planning for future urban systems on a regional rather than local basis.[3]

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[2]Walter Christaller, translated by C. W. Baskin, Central Places in Southern Germany, (Englewood Cliffs: Prentice-Hall Inc., 1966).

[3]Patrick N. O'Farrell notes the planning use of a centrality index in Ireland, P. N. O'Farrell, "A Proposed Methodological Basis

From the initial central place formulations of Christaller, it was clearly recognized that "neither population, nor area adequately described this centrality."[4] For example, centre A with a population of 5,000 is not necessarily twice as 'central' or relatively important as centre B with 2,500 people. Similarly, centre C might occupy 3,000 acres, while centre D only 1,000 acres, but it does not hold that centre C is three times as central as centre D. Obviously other factors give one settlement greater importance than others.

The economic activities carried on in a place were seen as a better indicator of centrality. But some activities do not add to a centre's local dominance or influence over its umland. Christaller had made the early distinction between central professions, providing central goods and services, and those dispersed professions.[5] The former are bound by necessity to a central location and therefore "are produced and offered at a few necessarily central points to be consumed

for the Determination of the Centrality and Rank of Central Places", Administration 16 (1968), p. 17. In Ontario, the Department of Economics and Development has planned for regional growth centres assessed on present urban centrality. Hans Carol, "Geographic Identification of Regional Growth Centres and Development Regions in Southern Ontario", Toronto, Nov. 1966, and Gerald Hodge, "The Identification of Growth Poles in Eastern Ontario", Toronto, July 1966. See also K. Stiglbauer, Josephine Abiodun, W. K. D. Davies and D. Grove and L. Huszar for planning applications in other countries. J. O. Abiodun, "Urban Hierarchy in a Developing Country ", Economic Geography 43 (1967), pp. 347-367; Karl Stiglbauer, "Some Problems of Central Places at the Lowest Level in Austria", Papers and Proceedings of the Regional Science Association, 18 (1967), pp. 47-66; W. K. D. Davies, "The Ranking of Service Centres: A Critical Review" Transactions of the Institute of British Geographers, 40 (1966), p. 51; David Grove and Laslo Huszar, The Towns of Ghana: the Role of Service Centres in Regional Planning, Ghana University Press, Accra (1964).

[4]Christaller, op. cit., p. 17.

[5]Christaller, op. cit., p. 19.

at many scattered points." This was only a very general distinction and, as evidenced in the literature to follow, has been easily complicated when, for example, some goods can be produced dispersedly and offered centrally (e.g. market garden produce), while others may be produced centrally and offered dispersedly (e.g. newspaper). Agreement has not been unanimous on the question of what constitutes a central activity in actual practice. This matter will be taken up later in chapter four.

Central economic activities, or more correctly, the sum of those central activities in a place, incur many of those same limitations as simple population when used as an indicator of importance over a region. Does a place with 20 central activities in 1920 have the same relative importance as a place with 55 central activities in 1950?

Therefore, most authors have generally accepted the ratio of various indices of activity-content to population, as best providing this comparative index of centrality. Before outlining these various indices which have denoted the activity-content of central places, an example is used to illustrate the idea of centrality.

Urban place A has 1,000 people and 40 functional units or functions[9] -- a ratio of one functional unit for every twenty-five people (1:25). As is the case with most urban places, these 40 functional units are supported not only by much of the 1,000 resident population of Place A, but also by the surrounding rural and urban population in its umland. In other words, some of these functional

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[6]To be defined more specifically later in this chapter. For now, it is sufficient to note that the term should refer to any consistently-measurable activity index.

units carried out in Place A will have a <u>physical</u> range beyond A's corporate limits.

Take a second urban place B, again with 1,000 people but with 50 functional units --a ratio of one functional unit for every twenty people (1:20). The assumption is generally made that places of approximately the same size perform about the same service or central activities. Tied to this is the general assumption that these same functions would have similar "thresholds" or numbers of consumers (or dollars in purchasing power) to support them. Therefore, with the same number of consumers required to support a given number of functions, one can deduce that "extra" consumers are drawn from the surrounding umland. "Extra" is only relative in the sense that when population and functions are graphed and an average curve or best-fit regression line is drawn, some centres can be seen to have "excess" or added centrality over their region.

Although not operationalized in this study, it can be noted that a denser population in the umland would make greater centrality possible. Therefore some measure of change in umland population-density should rightfully be incorporated.

The notion of centrality then acquires only relative importance, where, as per the example cited above, B has greater centrality than A. At another point in time, with urban growth, and increased settlement, place A may have ballooned to 10,000 people and 500 functional units (a ratio of 1:20), while place B could have grown slightly to 2,000 people and 80 functional units.

Therefore A has increased its centrality both absolutely through an increase from time 1 to time 2, and relatively with respect

to B at each time period. However, with the changes in settlement density, commuting habits and the increased use of multi-purpose trips (to mention only a few factors), this "absolute" increase in A's centrality may be deceptive. It must be analyzed relative to the change in centrality of <u>all</u> centres (or a sample thereof) from $t_1$ to $t_2$.

The rationale of relative centrality provides a good logical insight into the comparative importance of urban places as best summarized by Davies.[7]

A review of the terminology used to describe the various aspects of the activity-content of urban places is carried out in the following chapter as a prelude to discussing changes in centrality over time.

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[7]W. K. D. Davies (1966), <u>op. cit.</u>

CHAPTER II

CENTRALITY AS A MEASURE OF RELATIVE IMPORTANCE

In the 1930's and 1940's, human ecologists were viewing the
relationship between size of population and number of institutions
or institutionalized services in any given area. As Hawley later
points out, they were only able to draw the very general conclusion
that "the size of population affects in some more or less direct
manner, the number and variety of institutions associated with it."[1]
The inconclusiveness of such findings was illustrated where the popula-
tion required to serve one music store (or what central place theorists
now call its "threshold population"), varied between 1:2,500 and
1:12,000. Also, for the 1935 Business Census data, "the number of all
institutions per 1,000 population, showed a marked decline as size of
city increased"; a finding which seemingly contradicted the usual con-
clusion that number of institutions is directly related to city size.[2]

Although only studying the growth of population relative to
that of institutions, with no reference to centrality or relative
importance over a region, Hawley notes:

"the unreliability of a simple ratio of institutions to
population for use in making comparisons among cities is
further demonstrated by data on the behaviour of institutions
in depression conditions. It has been found that although
population withdraws its support from institutions and becomes

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[1]In place of what we will call "function", he has used the term
"institution", where an institution is defined as "any agency established
for the service of the general population", Amos Hawley, "An Ecological
Study of Urban Institutions", American Sociological Review, 6 (1941),
pp. 629-639.

[2]Ibid., p. 630.

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more self-sufficient, as represented in a general decline in per capita sales, the number of institutions actually increases. These facts lead to the suggestion that the number of institutions is not a proper measure of the amount of institutionalized activity in a community. It is entirely possible that size of institution varies with size of city in such a way as to obscure a positive correlation between amount of institutionalized activity and population."[3]

In light of these observations, Hawley goes on to re-examine the relationship in question through the consideration of the size of institution and the relationship of institutions with certain population variables other than sheer size. Therefore, as early as 1941, ecologists had well-defined views on the simple population:institution relationship in different size cities. They had coined the term "institution" to describe those economic activities found in a place, but concentrated on each institution, rather than the aggregate importance of the place.

Geographers had later taken up the study of the relationships between the population of a central place and the number of units of any economic activity which that place possesses. Studies by Brush, Bracey,[4] and others are among the early works which were observing this relationship primarily as a means of ranking centres in terms of their importance and, from this, testing Christaller's theoretical notions regarding hierarchies of centres. Terminology was vague and inconsistent as Brush, for example, speaks of retail units, functions

[3] Ibid., pp. 630-1

[4] John E. Brush, "The Hierarchy of Central Places in South-western Wisconsin", Geographical Review, 43 (1953), pp. 380-402; H. E. Bracey, "Towns as Rural Service Centres, an Index of Centrality with Special Reference to Somerset", Transactions of the Institute of British Geographers, 19 (1953), pp. 95-106; H. E. Bracey, "English Central Villages: Identification, Distribution and Functions", in K. Norborg (ed.), Proceedings of the IGU, (Lund: Gleerup, 1962), pp. 169-190.

and services without making any clear distinction,[5] whereas Bracey talks of the number of shops offering goods such as food, clothing and household articles, but not services such as laundry and hairdressing, which measure the importance of central villages.[6] Yet, in an earlier article Bracey[7] uses shops, establishments, services and professions with little clarification, probably viewing both shops and establishments as synonymous, while services and professions were the activities performed in them. More recent studies[8] have followed this same line, often in search of verification of Christaller's hierarchies or of thresholds for different goods and services.

But a greater proportion of the literature has expanded the terminology relating to the central activities carried out in an urban place. The breakdown which has tended to receive the widest acceptance was first used in part by Leeming[9] in the United Kingdom, and later by Thomas, and Stafford in the United States, and King in New Zealand.[10]

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[5]Brush (1953), op. cit., p. 387.

[6]H. E. Bracey (1962), op. cit.

[7]H. E. Bracey (1953), op. cit.

[8]Josephine Olu Abiodun (1967), op. cit.

[9]F. A. Leeming, "An Experimental Survey of Retail Shopping and Service Facilities in Part of North Leeds," Transactions of the Institute of British Geographers, (1959), pp. 133-152.

[10]E. N. Thomas, "Some Comments on the Functional Bases for Small Iowa Towns", Iowa Business Digest, (Winter: 1960), pp. 10-16; L. J. King, "The Functional Role of Small Towns in Canterbury," Proceedings of the Third New Zealand Geographical Conference, Palmerston North, 1963, pp. 139-169 and H. A. Stafford Jr. (1963), op. cit.

Berry's work[11] that follows the earlier Berry and Garrison Snohomish County, Washington study[12] uses much the same breakdown, which is as follows:

Function refers to a social and economic activity carried out in an urban place. In central place theory these are Christaller's central functions as outlined in chapter one, and would coincide with the term institution used by the ecologists like Hawley. This central function may sell any array of goods or perform any services that are required by the town and its umland.

Functional unit denotes one occurrence of a function. The distinction between function and functional unit only has relevance when speaking of their sum or totality in an urban place. The sum of the functions in an urban place, refers to the sum of each different type of activity regardless of number, whereas the sum of the functional units also includes frequency of occurrence. The former is reputedly a better measure of importance or attractiveness of smaller and medium-sized centres where "low order multi-purpose trips" enforce the attractiveness of a variety of functions, while the latter reflects the magnetism that a selection from a number of similar functional units accrues to larger urban places.

An establishment is then the physical structure in which the activity is performed and is analogous to the term "shop" used in earlier studies. More than one function can be carried on in each

[11] B. J. L. Berry, "The Impact of Expanding Metropolitan Communities of the Central Place Hierarchy," Annals of the Association of American Geographers, 50 (1960), pp. 112-116.

[12] B. J. L. Berry and W. L. Garrison, "The Functional Bases of the Central-Place Hierarchy," Economic Geography, 34 (1958), pp. 145-154.

establishment as illustrated by a general store that also serves as
a post office or a gasoline station that serves gas, does automotive
repairs in the garage and also acts as a distributor for naptha gas,
ice and kerosene. The higher order centres (i.e. ones supplying higher
order goods such as jewellry and furs) with greater specialization
would tend to have one function (or one functional unit in this case)
in each establishment, while smaller centres would have more than one
function per establishment.[13] But of more importance is the fact that
due to specialization, the lower order function (e.g. gasoline station)
usually has broken down to include many higher order functions (e.g.
gas bar, general garage, towing service, muffler service, transmission
service, tire dealer and so on).[14]

Thomas focuses interest on three indices (total number of
establishments, total number of functions and total number of functional
units) each of which reveals a somewhat different aspect of the over-all
distribution and magnitude of activities within an urban place.[15]

A summary of the relationships between these three indices and
population, as observed at one point in time, is presented as a pre-
liminary step to observing changes in the relationship through time.

[13]Berry and Barnum make this same point "because such combina-
tions as, for example, gas station and general store in the same
establishment in hamlets are recorded separately." B. J. L. Berry
and H. G. Barnum, "Aggregate Relations and Elemental Components of
Central Place Systems", Journal of Regional Science, 4 (1962), p. 37.

[14]Davies points this out as one of the major shortcomings in
Bracey's ranking of centres in Somerset. H. E. Bracey (1962), op. cit.;
W. K. D. Davies, (1966), op. cit., p. 52.

[15]E. N. Thomas (1960), op. cit., p. 11.

Probably the least attention has been focussed on the changes in number of establishments relative to population changes. This is partly due to the problem of multi-function shops, briefly mentioned earlier. O'Farrell points out the shortcomings of several past studies that "accorded the general type of business to the dominant line, thus failing to permit differentiation of establishments by functions". With such a prevalence of multi-purpose shops in provincial Ireland, he ranks centres by functional units rather than establishments.[16] Tarrant has avoided the problem of multi-purpose shops by simply ignoring those with more than two distinct types of goods.[17]

Despite these possible reasons for irregularities, it is interesting that Thomas[18] and Stafford[19] both find very high correlation coefficients (r = +0.96 and +0.929 respectively) indicating a close relationship between population and establishments. Berry and Barnum find an even stronger correspondence of 0.98, which, after transformation for greater "homoscedasticity" dropped slightly to 0.96. Upon fitting an "average" line (using the least squares method) to this graphed data, Thomas and Stafford find regression equations of

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[16]P. N. O'Farrell (1968), op. cit., p. 21.

[17]J. R. Tarrant, "A Note Concerning the Definition of Groups of Settlements for Central Place Hierarchy", Economic Geography, 44 (1968), pp. 144-45.

[18]Thomas (1960), op. cit.

[19]H. A. Stafford Jr. (1963), op. cit.

$y = 9.6 + 6.6x$ and $y = 5.49 + 3.8x$ respectively (where x was measured in 100's of people). Thomas' Iowa study has a steeper gradient and larger y-intercept value, but Stafford attributes this to the fact that twice as many functions are tallied in the Iowa study.[20]

Berry,[21] in observing variations in central place hierarchies, also compares the population of a centre with number of establishments (for different areas in the United States -- SW Iowa, NE South Dakota, the Rapid City area and the central places and county suburbs of Snohomish County) and although the results are only compared graphically on logarithmic paper, a strong correlation and consistent linear trend (except for places of less than 100 population and about 12 establishments) is shown. He concludes that "the responses to change will be varied; some stores will just grow in size, others will duplicate identical units, yet others will begin to specialize".[22]

Barnum likewise finds a linear trend in the relationship of population and business establishments in Germany with several deviant cases of excess population attributed to the presence of basic industry and commuters to a nearby large centre.[23] Thomas carries out a similar rationalization of the relatively fewer establishments in the town of Buffalo in his Iowa study, concluding that those residents of Buffalo

[20]Stafford, ibid., p. 169.

[21]B. J. L. Berry, Geography of Market Centres and Retail Distribution, (Englewood Cliffs: Prentice-Hall, 1967), pp. 36-39.

[22]Ibid., p. 37-38.

[23]H. Gardiner Barnum, "Market Centres and Hinterlands in Baden-Wurtemberg", University of Chicago Research Paper No. 103, (1966) pp. 18-20.

most likely patronize many establishments in nearby Davenport.[24] This explanation resorts to adding 'spatial notions' (in a purely descriptive sense) to account for any exceptional cases.[25]

From such a close positive correlation, Stafford concludes that "population changes over time are quickly reflected by changes in the number of establishments".[26] Though this inference may be drawn from his results, such has not actually been proven. Rather, he has only shown that population changes are reflected by changes in the number of establishments through different sizes of urban places. Growth occurs through time and the inertia which was expected to alter the population:establishment relationship may in fact be operative, though Stafford's study has incorrectly concluded its presence. By studying changes in the slope and intercept-values in the regression equation and the "closeness of fit" in the correlation coefficient, this study attempts to test Stafford's conclusions by looking at data from different points in time.

Far greater attention has been focussed on the relationship of functions and population. The early work of ecologists in the United States has been mentioned already in regard to stages of generalization in terminology.

Berry and Garrison[27] graph the population:central function relationship in Snohomish County, Washington while testing the notion

[24]Op. cit., p. 12.

[25]This is one point carried out successfully by Marshall in Bruce and Grey Counties in Ontario, Canada. J. U. Marshall (1964), op. cit.

[26]Stafford, op. cit., p. 169.

[27]B. J. L. Berry and W. L. Garrison (1958), op. cit.

of hierarchical classes of centres. They attribute exceptions in their generalized "levels" to a paucity of functions caused by the time lag (almost a "reverse inertia" in Stafford's sense) existing between population growth and development of service industries.[28]

Berry does document the strength of this relationship in a later study[29] again in Snohomish County. He contrasts the correlation coefficient ($r = 0.77$) obtained by including the larger metropolitan centres and it is slightly higher than that ($r = 0.75$) obtained in the earlier Snohomish study which purposefully excluded them. Berry asserts that an examination of the urban economic base leads to an appreciation of the deviant cases from the general population:central function relationship. In those places with excess population, he notes the inclusion of such basic activities as county seat, recreational area or residential suburb. The only example with excess functions includes many urban arterial functions extending out from Seattle, combined with the exclusion of non-contiguous residential subdivisions.[30] Although not discussed at this point, it is worthwhile to note that Berry chooses number of functions as the independent variable $(x)$ and population as the dependent variable $(y)$ a move which he continues in later studies.[31] Some discussion will follow on this point in the next chapter.

[28]Ibid., p. 154.

[29]B. J. L. Berry (1960), op. cit.

[30]Berry (1960), op. cit., p. 115.

[31]B. J. L. Berry, H. G. Barnum and R. J. Tennant, "Retail Location and Consumer Behaviour", Papers and Proceedings of the Regional Science Association, 9 (1962), pp. 65-106.

Thomas[32] carries out a more thorough regression and correlation analysis in Iowa. He finds a much smaller range and a slightly smaller average number of functions than establishments in each of his study places. His "best fit" regression line is distinctly curvilinear (i.e. $y = 39.91 \log x - 66.31$) inferring that, as population increases, relatively fewer functions are added. Although "generalizing beyond the limits of the available data", Thomas makes several very astute observations. He notes that there may be a definite limit to the functional complexity of, or number of functions in, urban places, in light of the curvilinear relationship between functions and population. Also, "once a certain level is reached, establishments are added much more rapidly than functions", suggesting that in larger places the number of functions is not as important as the number of establishments which includes duplicate functions.

Such a curvilinear relationship is also found by most other authors, but with even higher correlation coefficients than the early Berry and Garrison, and Berry studies. For example, Stafford finds a high correlation of $r = 0.892$ in Southern Illinois and saw this as comparable to that of Thomas in Iowa, King in Canterbury, New Zealand[33] and Vuicich[34] in Iowa. Lesser coefficients are obtained by Scott[35] where he only calculates for twenty Tasmanian centres in the "towns

[32]Thomas, (1960), op. cit., pp. 14-15.

[33]L. J. King (1963), op. cit.

[34]George Vuicich, "An Analysis of the Spacing of Small Towns in Iowa", unpub. Ph.D., State University of Iowa, 1960.

[35]Peter Scott, "The Hierarchy of Central Places in Tasmania", Australian Geographer, 9 (1964), pp. 134-147.

and cities" class, and by Lindstahl[36] in Finland where he includes

manufacturing activities in the population:function relationship.

Using a log-linear graph and obtaining a linear relationship (compared

to the curvilinear relationship on normal graph paper), Berry, Barnum

and Tennant, Berry and O'Farrell[37] all find very high correlations.

This relationship was particularly strong above a population of about

1,100 and Berry, Barnum and Tennant therefore leave "hamlets" (places

with less than ten central functions) out of their calculations, noting

that "hamlets, once the basic element in the American settlement fabric,

are now in the final stage of decline".[38]

The relationship of functional units to population is actually

an extension of that of functions and population, but definitely illus-

trates a different aspect of centrality. Recalling that each occurrence

of a function constitutes one functional unit, then the number of

functions would be equivalent to the number of functional units, if

there were but one occurrence of each function. The correlation co-

efficient of functions and functional units will diverge from one

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[36] Sigvard Lindstahl, "A Plan for the Investigation of Central
Places in Agricultural Communities", in K. Norborg (ed.), Proceedings
of the IGU, (Lund: Gleerup, 1962), pp. 285-295.

[37] Berry, Barnum and Tennant (1962), op. cit., p. 70; Berry
(1967), op. cit., p. 36 and O'Farrell (1968), op. cit., p. 30.

[38] Berry, Barnum & Tennant (1962), ibid., pp. 70-81. Trewartha
studied the early importance of hamlets in southwestern Wisconsin,
while Borchert in the U.S. and Stiglbauer in Austria have studied the
implications of their decline. G. T. Trewartha, "The Unincorporated
Hamlet: One Element of the American Settlement Fabric", Annals of the
Association of American Geographers, 33 (1943), pp. 32-81; John Borchert,
"The Urbanization of the Upper Midwest 1930-1960", Urban Report #2,
Upper Midwest Economic Study, 1963 and Karl Stiglbauer (1967), op. cit.

In a much less rigorous study, McIntire makes the valid point
that population bears little or no relation to the number of functions

towards zero as more functional units are added.  Again, the number
of functions denotes variety of activities where no two of the same
are counted, while the number of functional units is an aggregate of
the variety of activities regardless of duplications.

Berry, Barnum and Tennant[39] find a very high correlation of
0.979 between population (again the dependent variable) and functional
units (the independent variable).  The best-fit regression line is also
linear of the form:

Population = 17.6 Functional Units  +  162.7

Where population is measured in thousands and

functional units in hundreds.

Stafford[40] also finds a very high correlation coefficient
(0.934) with a linear regression equation of $y = 6.18 + 4.2x$.  Stafford
again accounts for the differences in this equation and that of Thomas
($y = 15.03 + 8.0x$) "in terms of variations in data collection rather
than by any fundamental difference in the functional base of small towns
in the two areas".  King, in his New Zealand study, finds a similarly
high correlation coefficient of 0.932 which leads him to confirm the
belief that the majority of the small towns in Canterbury act as service

in central places on the Navajo Indian Reservation, though hierarchies
based on functions definitely exist.  His example is obviously an
exceptional case where historical accident and the maintenance of an
"alienated closed system" tends to distort the general pattern.

Elliott G. McIntire, "Central Places on the Navajo Reservation",
Yearbook of the Association of Pacific Coast Geographers, 29 (1967),
pp. 91-96.

[39]Berrry, Barnum & Tennant, (1962), op. cit., p. 69.

[40]Stafford, (1963), op. cit., p. 171.

centres.[41]   Generally high relationships are also obtained by Vuicich

in Iowa and Scott, who again only views twenty centres in the "towns

and cities" grouping in Tasmania.

Davies outlines another refinement in terminology which is

relevant to this examination of centrality and particularly its changes

through time.[42]   In a later article,[43] he criticizes the methods, which

have already been outlined, as crude approximations of the rank or

centrality of urban places.  He therefore outlines various weighting

measures which better approximate this rank, noting some of the dis-

advantages of each.  Davies himself uses number of employees to weight

each outlet, while Ambrose weights each good (a further breakdown of

function) by the number of employees.[44]   Hutton has weighted each

function by its floor-space ratio, whereas Vuicich has used the Iowa

2% sales tax records to indicate business conducted.[45]   This latter

weighting most closely approximates the monetary weighting (value of

goods and services sold) which Davies sees as best offering comparability

to these functions,[46] but O'Farrell has even refined this further to

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[41]King (1963), op. cit., p. 148.

[42]W. K. D. Davies, "Some Considerations of Scale in Central
Place Analysis", Tijdschrift voor Economische en Sociale Geografie,
(Nov/Dec. 1965), pp. 221-227.

[43]W. K. D. Davies (1966), op. cit.

[44]W. K. D. Davies, "Centrality and the Central-Place Hierarchy",
Urban Studies, 4 (1967), p. 63, and P. J. Ambrose, "An Analysis of
Intra-Urban Retail and Service Activity in the Sussex Coast Conurbation",
unpub. Ph.D., University of Sussex, (1968).

[45]C. L. A. Hutton, "Functional Differentiation Among Small Towns
in the Edmonton Area", unpub. M.A. thesis, University of Alberta, (1965)
and Vuicich (1960), op. cit., p. 14.

[46]Davies (1965), op. cit.

note that the _profit_, rather than simple value, is more accurate in eliminating the differences incurred by variable size functions and variable values of goods and services.[47]

In summary, changes are known to be occurring in the variety and composition of central activities. In order to analyze these changes, central activities have been broken down into establishments, functions, and functional units and compared with population to give a measure of excess or deficit importance relative to other urban centres. Several weighting measures have been mentioned which provide more comparable functional indices. Correlation and regression results have been obtained and inferences drawn by various authors. These inferences are assessed in this study in light of findings at different points in time in Kent and Lambton counties in Southwestern Ontario.

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[47]O'Farrell (1968), _op. cit._

CHAPTER III

CHOICE OF DATA AND THE STUDY AREA

In order to observe temporal changes in the centrality of
small urban centres, the early historical directories were used.
Of great significance was the detail contained in these historical
directories which could easily be handled without lengthy field
observation.

The directories, although now an archival source, served the
same purpose in their time as the telephone directories, or even some
small-town directories, do today. They were published at several
levels of scale, ranging from the national in 1851 and 1857, to the
county level in 1866.[1] The need for such directories was associated
with the loose communications network and the emphasis on mail delivery
as the most important means of contact. Their utility diminished as
a telephone and road network penetrated Southern Ontario, and as the
population increased making data collection more costly and less
accurate.

Once the directories had been decided on as a source of data,
it was found that no limitations were placed on the selection of a

[1]R. W. S. Mackay, The Canada Directory. Montreal: John Lovell
Pub., 1851; The Canada Directory for 1957-8. Montreal: John Lovell
Co., 1957 and Gazetteer and Directory of the Counties of Kent, Lambton
and Essex 1866-67. Toronto: McEvoy and Co., 1866. Directories were
normally published on a province-wide basis, although some were re-
stricted to certain cities (Ottawa, Toronto, Montreal) and certain
private railroad companies (Grand Trunk and Great Western).

study area in terms of data availability.  However, several other
factors influenced the final choice of Kent and Lambton counties in
southwestern Ontario (see figure 1).

The primary concern is to view small urban places -- not just
those incorporated places at the lowest scale of the "urban continuum",
but any clustering of population that included central or service
activities.  Small urban places are preferred because of easy tabulation
of data, and because of their omission by many past authors as distorting
the general pattern they were intuitively hoping to substantiate.[2]  Also,
the general population:central activity relationship would be distorted
in larger urban centres due to increased chance of error and more non-
central activities.

It seems preferable to have as complete an urban system as
possible[3] (with few centres subordinate to larger places in adjacent
areas), while maintaining any distinct and observable "natural" bound-
aries.  Kent and Lambton counties most clearly satisfy these criteria,
bounded by natural features like Lake Huron, the St. Clair River, Lake
St. Clair, and Lake Erie, with only the extreme south-western and the
eastern boundaries bordering other counties.  London at this time
(1846-1907) did not have any real significance over the area (as arbi-
trarily determined by "subjective linkages"[4] given in the directories).
No major American city strongly influences the area as would be the
case with Detroit over Essex county.

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[2] Berry, Barnum and Tennant (1962), op. cit.

[3] J. U. Marshall (1964), op. cit.

[4] These 'subjective linkages' (my terminology) were given in the
directories in terms of the number of miles to the county town, to the
nearest bank, the nearest station and to any other large centre.

Figure 1　27



LOCATION OF THE STUDY AREA
IN
SOUTHWESTERN ONTARIO

STUDY AREA
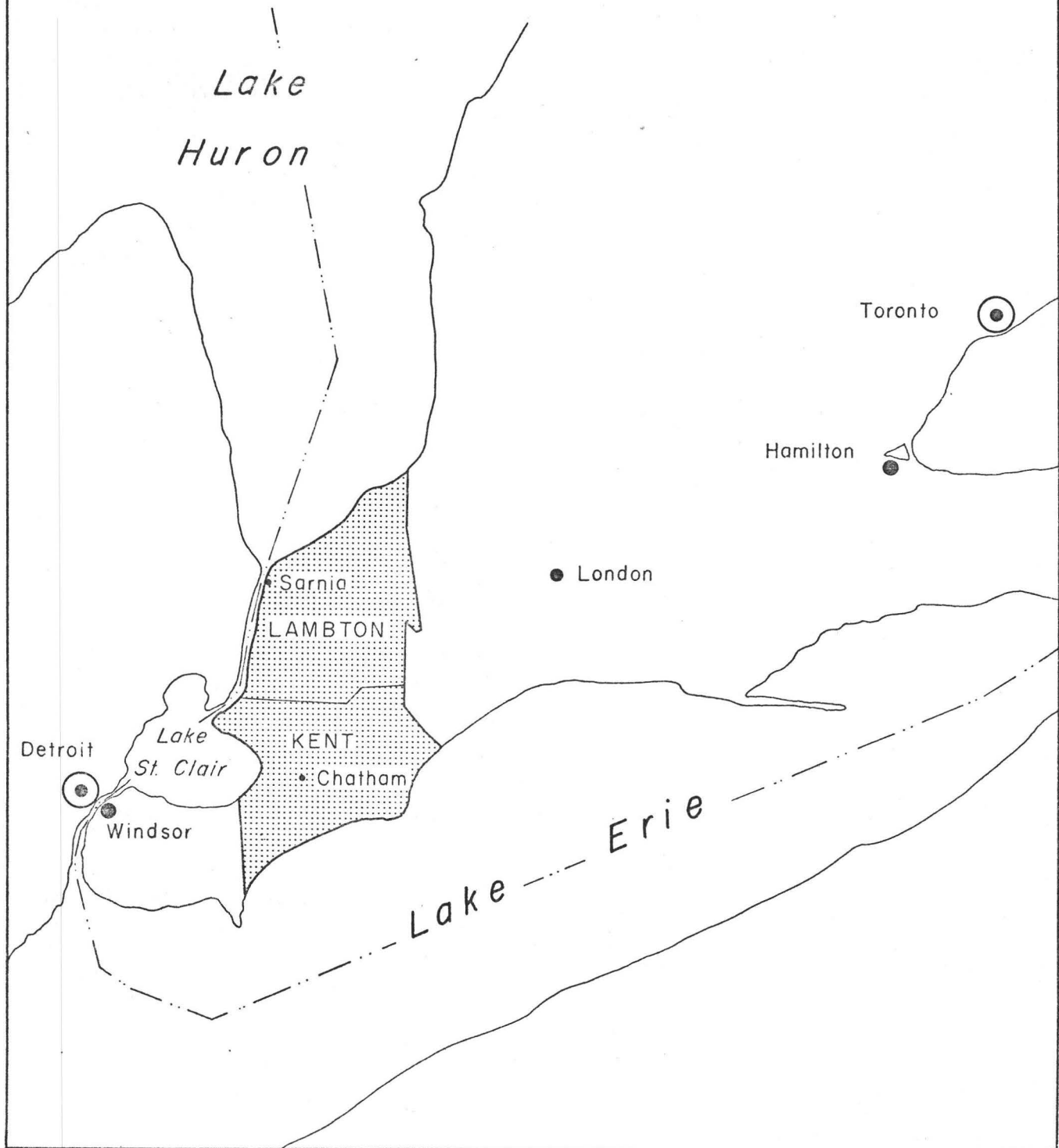
The settlement history of the area is well-documented,[5] began early based on agriculture with some physical resource development and remains fairly continuous throughout the time of study (1846-1907). Lauriston gives a complete chronological account of the area and its specific settlements, noting a quiet and orderly development for the first two decades of its settlement (1835-1855), until the first railroad came in 1856 and the discovery of petroleum in the Black Creek area in 1857. Though somewhat incidental, the study area provides convenient access for personal observation and familiarization, and leads to a better appreciation of the dominance of Sarnia and Chatham which has extended even to the present day.

Though not areally restricted, the historical directories are limited in their temporal coverage. While ten-year intervals are preferred with a range from about 1850 to 1950, the directories, unfortunately, ceased to be published after 1910. Therefore, with the study area of Kent and Lambton counties already selected, the available directories from 1846 to 1907 were evaluated, trying to cover the sixty-year range in five-year intervals. The five-year interval was seen as sufficient to measure change in activities in response to changes in population and yet, still allow for interpolation. Unfortunately, some gaps were still left where directories were non-existent, while other intervals were shortened to two years where a directory appeared suspect. The final selection of directories was (by date of publication only): 1857, 1864, 1866, 1869, 1871, 1882, 1888, 1892, 1898, 1903, and 1907.

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[5]For example Victor Lauriston, Lambton County's Hundred Years 1849-1949, 1949 and Romantic Kent: the Story of a County 1626-1952, 1952 by the same author, as well as active documentation and research by both the Lambton and Kent historical Societies.

All places were listed from each directory, with the only proviso that they be located within the areal limits of Kent and Lambton counties. This listing is given in appendix I. From this listing, all places with incomplete population or central activity information were immediately omitted. For any other place to be included, no restrictions are placed as to the minimum population, but rather a place, to be considered as central to its region, has to have two or more "labour units",[6] or one labour unit which performs two or more functions.[7] An example of the former case is an urban place with a grocer and a blacksmith, while the latter might be one man who handles the general store and the post office.

Some places have changed their name during the period of study. Many of these place-name changes were given in the directories, while several local histories were used to supplement this information.[8] Any place which changed its name was tabulated only under its final name (as shown in appendix I). There did not appear to be any major changes in size (population or activities) that would accompany a change of place name, if, for example, annexation or amalgamation had occurred. A final list of all places with their corresponding population and labour units is shown in appendix II, from which correlation and regression analyses are carried out.

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[6]A labour unit or central labour unit refers to a productive employee who is working at a central activity in an urban place.

[7]The use of such a term to delimit what places should be included stems from refinements made on the definition used by Hodge. Gerald Hodge, "The Prediction of Trade Centre Viability in the Great Plains", unpub. Ph.D. MIT, 1964.

[8]These include Victor Lauriston (1949), op. cit.; Jean Turnbull Elford, A History of Lambton County, 1967 and A. J. Johnston, Lambton County Place Names, 1925.

Some shadow of doubt should be cast over the form and the validity of the data even before investigation proceeds. Referring to appendix II, it is readily apparent that most of the population data are rounded to fifty's or even hundred's. This is obvious in the graph interpolation stage. Small changes, therefore, might hold little significance for some places, while a place that maintains a constant population for a long period of time (e.g. Bothwell from 1882 to 1907 maintains 1000 people) should be regarded as questionable. There are other cases where population data have been taken from the most recent census and this might be the same for two consecutive time periods (e.g. Forest and Ridgetown both in 1892 and 1898). Other places seem to have _too_ great a difference in population where the time interval is very short (e.g. Bothwell with 300 in 1864, 3700 in 1866 and 1600 in 1869), but this particular example was checked along with several others and a corresponding increase in labour units was found. These drastic changes are often too typical of the small-town fortunes of places during the early period of settlement. Whereas the river would give early prominence to one settlement, the railroad would transfer it to another, and resource development (e.g. discovery of oil) might again sway the centre of importance. Changes were generally fast, but activities seemed to re-adjust quickly and were very mobile.[9]

The choice of central activities is outlined in the next chapter and there seems to be little reason to distrust those occupations listed. One example has a school and church listed among the establishments of a place, and yet neither a minister nor a teacher

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[9]This can be shown to a limited degree by the turnover in owners of establishments who are listed in each place at each point in time; but a thorough examination of this type is beyond the scope of this study.

are listed within the occupations therein. One explanation might be that in these very small urban and rural parishes, transient ministers and teachers were a common occurrence where demand was relatively low and the family unit carried out many of these functions.

While directories vary considerably in their detail and content (e.g. 1846 and 1851 are considered as incomplete, while 1888 had excellent coverage and detail), they generally form a reliable and worthwhile data source which well might receive increased attention in the future as their existence becomes better known.

CHAPTER IV

'LABOUR UNITS' DEFINED

The relationship between population and various indicators
of central activities (establishments, functions and functional units)
provides an adequate measure of centrality which has been sharpened
with various "weighting" measures. In observing changes through time,
some of these indicators of central activities and their weighting
measures lose their significance and either do not adequately describe
the activity-content of a place at one point in time, or are not com-
parable through time.

It is easier to rationalize why these other terms are not
appropriate once a data source has been selected which logically fits
in with the changes in terminology outlined in chapter two.

The format of the data varies slightly for each directory, but
generally includes: place name, "subjective classification" (i.e.
station, post office, hamlet, flourishing village, etc.), its township
and county, its "geographical position" (on a river, railroad or road),
its "linkages" (miles to the county town, the nearest bank or station,
and frequency of mail delivery), its population and employed residents
with their occupations.

An example in 1869[1] is as follows:

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[1]C. E. Anderson & Company, The Province of Ontario Gazetteer
and Directory, (Toronto: Robertson and Cook Pub., 1869), p. 570.

<u>Widder</u> - a village in the Township of Bosanquet, County Lambton, 32 miles from Sarnia, the County Town and 1-1/4 from Widder Station. Stages to and from Arkona.   Population 200.

                    Bethune, Donald, grocer
                    Chase, Asa, hotel keeper
                    Chester, John, farmer
                    Crawford, Thomas, farmer
                    Dalziel, Andrew, blacksmith
                    Dalziel, John, manager saw mill
                    Decker, Isaac, proprietor saw mill
                    Donald, Archibald, lumber merchant
                    Duffus, Adam, postmaster, merchant
                    Elliott, John, lumber merchant
                    English, Alexander, farmer
                    Goodfellow, Rev. Peter (Presbyterian)
                    Johnson, Hiram, wagon maker
                    Kier, William, shoemaker
                    Lackey, John, farmer
                    Long, John, bookkeeper
                    Munger, Elijah, tanner
                    Munnes, W. A. M.D.
                    McKellar, Donald, farmer
                    McKellar, P., J.P.
                    McMillan, Thomas, saddler & tanner
                    McNab, James, miller
                    Owens, John, Prop. saw mill
                    Tidball, Robert, shoemaker

Recall in chapter two that O'Farrell and Davies have both developed a "functional index" based on the number of units in any particular function as a percentage of the total number of functional units in the study area, and then summed these indices for all functions in an urban place to give the centrality or relative importance of that place.  Without going into any more detail on their method, they concluded that functional units were the best measure of centrality for small urban places.  Davies and O'Farrell also dwell at considerable length on the various weighting measures that augment these rather crude indices.

In the example of the hamlet of Widder in 1869, if all those people performing central activities within that place are summed

there are 19 "labour units".[2]  These labour units are functional
units weighted by number of employees, where no employee is counted
more than once.

The only assumption necessary in the use of a 'labour unit'
index is that each man spends the same amount of time at his one or
more occupations.  Therefore, again in the case of Widder in 1869, it
is assumed that Donald Bethune, grocer, and Asa Chase, hotel keeper,
and Adam Duffus, postmaster and merchant, all work towards the same
general end of sustaining themselves.  In general this assumes average
wages and average expenditures throughout, an unlikely assumption, but
expected to balance itself in the long-run situation.  Therefore, it
does not matter that a man might be working at more than one occupation,
because it is assumed that he has an average output of time and energy,
gets average wages in return for his efforts and spends an average
amount from them.

In making this assumption, the subjectivity at the data tabula-
tion stage has been eliminated and the validity of any conclusions
rests on the accuracy of the data collection and the directories them-
selves (discussed in chapter 3).  This subjectivity at the data tabula-
tion stage was one of the major inherent weaknesses in the use of
functions to measure centrality and these problems were only compounded
in an analysis over time.

For example, functions which exist at one point in time might
cease to exist because of changes in technology and consumer preferences

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[2]This term "labour unit" or "central labour unit" was derived in
discussion with Dr. John Marshall to best describe those gainfully
employed in central activities in a place.  It was selected over
"occupational unit", for example, because one man could have more than
one occupation (e.g. postmaster and merchant).

(e.g. blacksmith, cooper or tanner). These changes in functions through time were neglible if there is a simple one to one replacement of dis-used functions in the same urban place with no growth or decline (e.g. Place A with population 200 and 12 functional units still has population 200 and 12 functional units at time period two, but the four blacksmith shops are replaced by four automobile garages). The probability of such an example seems remote because of changing tasks through time carried out by various functions. For example, the blacksmith might move into wrought iron fences and household utensils as 'shoeing' horses declined. Comparability between the blacksmith function and its 'replacement' function, or simply the blacksmith function evolving through time, is lost in the functional unit index, but, with the assumptions outlined earlier, remains comparable for the 'labour unit' index. The weighting measures outlined by Davies and O'Farrell likewise lack comparability and could only be brought in line by changing monetary values to some 'constant' dollar value.

In all likelihood, more functions are introduced through time to serve the same population as fewer functions had served in the past. Technology and increased affluence or development can be regarded as responsible for this change (e.g. numerous appliance shops, household repairs and servicing, laundromats etc.). Therefore, beyond the scope of this study might be an investigation of the increase in number of functions through time while population and even centrality (which was previously measured by the population:function relationship) remains stable.

Basic to this entire question of the use of functions in temporal analysis in central place theory, is the "subjective" checklist of all functions required at each point in time and the necessity of having this checklist continuous and consistent through time. Thomas says that he prepared this list from previous experience and amended it in the field where necessary.[3] However, with the changes that have already been described in functions through time, such a checklist seems quite improbable for any temporal study.

The use of establishments through time would seemingly offer the same lack of comparability as functions, though not hindered by the subjective definition of what constitutes 'one function'.

Therefore, based on the logic of its assumptions and its development from the already asserted terminology describing the activity-content of central places, the relationship of labour units to population is justified as a means of viewing the changing centrality of small urban places.

Before an analysis of the results of such an index, some discussion of those central functions, or in this case "central occupations", which were recognized as contributing to the labour unit index, is necessary.

Recall the brief discussion in chapter one in which Christaller laid down "generalities" defining central goods and services. Unfortunately, these generalities have not been expanded or clarified in later studies. They include the designation of a place as "central" when "the inhabitants have professions which are bound by necessity

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[3] Thomas (1960), op. cit., p. 11.

to a central location."[4] Christaller notes the distinction between central, dispersed and indifferent goods and services, avoiding Englander's neither all-inclusive nor exact distinction between urban and rural goods. The central occupations which are the basis for the labour units index, serve also as a tie-in with Christaller's original central professions.

Continuing, Christaller defines central goods and services as those "produced and offered at a few necessarily central points in order to be consumed at many scattered points."[5] The offering of goods and services, rather than the production, is more often bound to a central place. These central services include trade, banking, many handicraft industries, state administration, cultural and spiritual offerings, professional and business organizations, transportation and sanitation.[6] From these vague beginnings it has been largely a matter of personal judgment as to what goods and services, or more generally, what functions or activities should be considered as 'central'.

Many studies avoid any need for a complete clarification of what is, or what is not, a central activity by selecting certain key functions, which they intuitively feel are central, and base their central place system or existence of a hierarchy of centres on these key functions.[7]

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[4] Christaller (1966), op. cit., p. 19.

[5] Ibid., p. 19.

[6] Ibid., p. 20.

[7] Davies (1966), op. cit., p. 53, points out how the use of key criteria, by men like Smailes, Hartley, Brush and Carter, have time and space limitations so that an establishment may vary in functional status in both dimensions and its use in another context might be completely misleading.

Abiodun[8] points out the inapplicability of many _key_ functions in a developing country, just as Ullman[9] points out that Christaller's indicator of relative importance of places (the telephone) does not necessarily hold true in the United States.

Bracey[10] avoids the problem by returning to a method similar to that used by American rural sociologists. He interviews the rural residents as to their place of patronage and constructs a centrality figure based on the results. However, he only includes fifteen services (seven kinds of shops and eight professions), acknowledging the omission of educational services, specialized medical consultation, and recreation, while paying regard only to the ordinary rather than the unusual shopping and professional services.

Thomas is more specific in noting that interest is not restricted to commercial activities, but rather focusses on a much broader group of activities which lend either direct or indirect support to the economic base of towns. An activity is considered as providing support even if it is one which merely draws people into town so that the probability of their spending money on some economic activity is increased.[11] This general constraint was imposed in an attempt to isolate the functional bases of small towns in Iowa.

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[8]Abiodun (1967), _op. cit._

[9]Edward L. Ullman, "A Theory of Location for Cities", _American Journal of Sociology_, 46 (1941), pp. 853-864.

[10]Bracey (1953), _op. cit._, pp. 96-97.

[11]Thomas (1960), _op. cit._, p. 11.

In a somewhat later comparative study in southern Illinois, Stafford[12] prepares a list of functions which he intuitively expects to be present, and supplemented this with later field research as Thomas had done several years earlier. His final list of functions (totalling 60) is termed "less exhaustive" than that of Thomas (121 functions), with meeting halls and insurance agencies the most frequently omitted in the former. Also, "data were collected for many more than the 60 functions finally used in the analysis, but these data were not included in the final tally because classification difficulties led to considerable distrust of their accuracy." Therefore, it appears that Stafford has apparently failed to construct any meaningful and rigid definition for the inclusion or exclusion of central versus non-central activities. For the most frequently occurring functions in both Iowa and southern Illinois, it is interesting that Stafford was able to rationalize local differences based on variations in past history and present regional conditions.

In a study in Canterbury district, New Zealand, King[13] has only briefly defined function as "any class of economic activity", but emphasizes the preliminary nature of the study because the list of functions was incomplete. "The omission of some functions, notably 'halls' and 'churches' was dictated by expediency in that much of the data on functions were obtained from the Universal Business Directory, which did not list these functions consistently." His analysis is therefore concerned only with the 51 functions which were variates or which occur more than once in any of the urban places.

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[12]Stafford (1963), op. cit.

[13]King (1963), op. cit.

In all three of these early studies by Thomas, Stafford and King, no specific mention is made of exactly what activity is central in the Christallerian context. Yet, there must have been some judgment made in the field, whereby, for example, general stores, barber shops and doctor's offices were included, whereas steel manufacturing, distilling and brewing and salt-mining were in some cases excluded as being non-central activities.

Later studies have only confused this inconclusiveness. Lindstahl[14], for example, has collected data for manufacturing industries, economic points of activity (shops), social points of activity (libraries) and other objects of interest (churches). He arrives at 22 different activities -- a very low number because a "specialty shop" classification remained undifferentiated and manufacturing was included, "notwithstanding the fact that many scholars do not consider manufacturing a central function."[15]

Marshall, in his recent doctoral dissertation,[16] reports that resorts, manufacturing and administrative functions "swell" the population of a central place, so that the population indicates greater centrality for that urban place than actually occurs based on its central activities.

With the particular empirical study outlined in chapter three in mind, and yet with a view to the most general application to all central place discussions, two criteria are proposed to define a central

[14]Lindstahl (1962), op. cit.

[15]Ibid., p. 292.

[16]Marshall (1968), op. cit., p. 134.

activity.[17] Firstly, the goods that it produces and the services that it carries out, should be destined for a final market or its ultimate consumer. Secondly, the activity should be operated on a year-round or continuous basis. It was felt that these two criteria, though definitely not the ultimate constraints, offer a best 'first approximation' to choose central activities.

Although not explicitly refined to any degree, it is felt that any activity which has <u>any portion</u> of its final market in its immediate umland or complementary region, should be considered as 'central'. For example, a crude oil refinery and drilling operation that sells a small portion of its final product as stove and lamp fuel directly to local residents would be included as a central activity. This is a very contentious point (that <u>any</u> amount consumed in a local market should be sufficient to make an activity central), but it is seen as justified because no data are readily available on place of final consumption.

In this particular study area of Kent and Lambton counties, some of the central activities are now reviewed. It is significant that an activity, which might now be considered as manufacturing or non-central, could at some earlier point in time definitely be central. Saw mills, grist and flax mills, stave and barrell factories and most other "local industries" were initiated to serve a local market, definitely in terms of the "production" or milling of grain, but also in terms of "offering" or selling of milled grain back to the local residents. Wagon makers, tanners, distillers, cabinet-makers and foundry

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[17]These criteria evolved in discussions with Drs. P. J. Ambrose and J. U. Marshall, and are generally acceptable in light of previous economists' writings.

workers also served a, then, clearly defined local area which could
have expanded into an industrial enterprise as development occurred.
The exact time of change in an activity, from central to non-central
could possibly be calculated if data concerning the final market of
all goods were available in a reliable and continuous form.

With regard to the empirical study which concerns itself with
central occupations rather than central activities; farmers are listed
in many urban places, but are excluded from the "labour unit" index.
Justices of the Peace, customs collectors, county or township clerks,
steamboat and railway agents, bailiffs and wardens are all included
as central occupations as it is felt that they serve a final market
in the immediate area.

The most questionable occupations are engaged in the oil
activity that mounted after 1865 in many parts of Lambton county.
Drillers, refiners, shippers, agents, owners, and suppliers flooded
many towns like Oil Springs, Petrolea and Oil City and had resounding
effects on the surrounding countryside. Since these operations still
sell an admittedly decreasing portion of their product to local con-
sumers, they should be included. If the petroleum operation is broken
down into its various functions it becomes obvious that drillers, for
example, are more non-central.

At several points in time, the directories mention fishermen,
who are excluded because they are not employed year-round though their
final market might be in the immediate area, and many labourers and
railroad checkers, who were questionably included in the labour unit
index. It might be argued that the railroad's location was strictly

a geographical decision based on a fording point across the St. Clair River. The crossing is narrow and the river is swift enough to prevent ice from jamming in winter. However, the railroad moved its terminus to Sarnia once the river had been tunnelled. These railroad employees are, nevertheless, included in this research because of their service and repair activity and the presence of a highly local final market for their services. As time progressed, the railroad served a decreasingly local function and this activity would be obviously more non-central.

These examples only serve to illustrate how arbitrary the two criteria of year-round operation and a final market can be in actual practice. Although the notion of what constitutes a central activity, and therefore a central occupation, has long been used, it still lacks any precise definition which is comparable in all cases.

CHAPTER V

ANALYSIS

It must be emphasized at this stage that the nature of this
research and therefore of this data analysis, was purposefully set
out as an exploratory investigation,[1] rather than an attempt to accept
or reject an hypothesis.

Thomas, King and Stafford,[2] the three main comparative works
on the functional bases or activity-content of small towns, all use
simple correlation and regression analysis, and, in order to offer some
comparability of results, these statistical techniques are employed
here.

The use of correlation and regression analysis in geographic
research is set out very clearly by King.[3] He notes the seldom empha-
sized distinction between regression and correlation -- the former is
used where a functional relationship is postulated, the latter considers
only the covariation of variables with the emphasis on the degree to
which the values vary together.

With particular regard to the population:activity relationship,
not only the degree to which the values vary together, but also the

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[1]In the same vein as L. Curry's statement in "The Random Spatial
Economy: An Exploration in Settlement Theory", Annals of the Association
of American Geographers, 54 (1964), pp. 138-146.

[2]Op. cit.

[3]Leslie J. King, Statistical Analysis in Geography, (Englewood
Cliffs: Prentice-Hall Inc., 1969), chapter 6, especially pp. 118-120.

change in one variable (labour units), in response to change in
another variable (population) is of interest here. Therefore, both
correlation and regression techniques are used.

Robinson and Bryson[4] review the analysis of _time_ change using
correlation and regression, and then analyze the _place_ or spatial
change which they saw as posing uniquely geographical problems about
the areal distribution of their correspondence. Many authors, Robinson
and Bryson included, emphatically warn that "a regression equation and
a correlation coefficient are ways of describing the relation between
two series of numbers; they _explain_ nothing, nor do they imply cause
and effect."[5]

Population was selected as the independent or control variable
and labour units as the dependent or response variable. As King points
out,[6] the selection of these variables is made entirely within the con-
text of the problem to be solved. Population is the original and _more_
independent of the two variables. People first move into an area and
then set up their milling or blacksmith establishments. An increase
in population using these activities also permits an increase in the

---

[4]A. H. Robinson and R. A. Bryson, "A Method for Describing
Quantitatively the Correspondence of Geographical Distributions",
_Annals of the Association of American Geographers_, 47 (1957),
pp. 379-391.

[5]_Ibid._, p. 388; John E. Freund, _Modern Elementary Statistics_,
(Englewood Cliffs: Prentice-Hall Inc., 1966), p. 359 and Mordecai
Ezekiel and Karl A. Fox, _Methods of Correlation and Regression Analysis:
Linear and Curvilinear_, (New York: John Wiley & Sons, 1959), p. 475.

[6]King (1969), _op. cit._, pp. 119-120.

Table 1

SUMMARY OF CORRELATION AND

REGRESSION ANALYSIS

| DATE | $\bar{x}$ | $\bar{y}$ | r | b | a | s.e.e. | n |
|------|-------|-------|----------|--------|---------|---------|-----|
| 1857 | 438.87 | 29.65 | 0.941153 | 0.0424 | 11.0261 | 16.4141 | 31 |
| 1864 | 483.58 | 40.00 | 0.958523 | 0.0572 | 12.3207 | 15.2582 | 31 |
| 1866 | 453.54 | 52.39 | 0.974444 | 0.1003 | 6.9053 | 17.9399 | 41 |
| 1869 | 471.84 | 38.28 | 0.964014 | 0.0697 | 5.3976 | 17.0567 | 43 |
| 1871 | 434.52 | 48.87 | 0.990968 | 0.1188 | -2.7524 | 15.1636 | 63 |
| 1882 | 562.30 | 41.83 | 0.959008 | 0.0631 | 6.3265 | 21.3613 | 69 |
| 1888 | 519.85 | 27.55 | 0.974890 | 0.0456 | 3.8202 | 12.7120 | 119 |
| 1892 | 476.87 | 28.65 | 0.973194 | 0.0499 | 4.8306 | 14.1016 | 124 |
| 1898 | 520.03 | 27.39 | 0.983010 | 0.0556 | -1.5341 | 13,3513 | 114 |
| 1903 | 495.03 | 25.31 | 0.983890 | 0.0499 | 0.6158 | 11.8376 | 110 |
| 1907 | 851.52 | 37.32 | 0.979288 | 0.0343 | 8.0187 | 15.5544 | 66 |

where    $\bar{x}$ is the population mean,

$\bar{y}$ is the labour units mean,

r is the correlation coefficient

b is the slope or regression coefficient

a is the y-intercept

s.e.e. is the standard error of estimate

and n is the number of observations

Figure 2                                                   47

# 1857

Figure 3                    48

# 1864

Figure 4                                      49

# 1866

Figure 5

Figure 6

51

# 1871

Figure 7                                    52

# 1882



Y
LABOUR UNITS
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0

• one occurrence
✳ two occurrences
✧ three occurrences

n = 69
r = 0.959

$Y = 6.33 + 0.063IX$

0    500   1000         2000         3000         4000         5000         6000         7000   X

POPULATION

Inset

50
40
30
20
10
5
0
0    125   250   375   500   625   750

Figure 8                                         53

# 1888

Figure 9                                    54

# 1892

Figure 10                                    55

# 1898

Figure 11                                                    56

# 1903

Figure 12                                        57
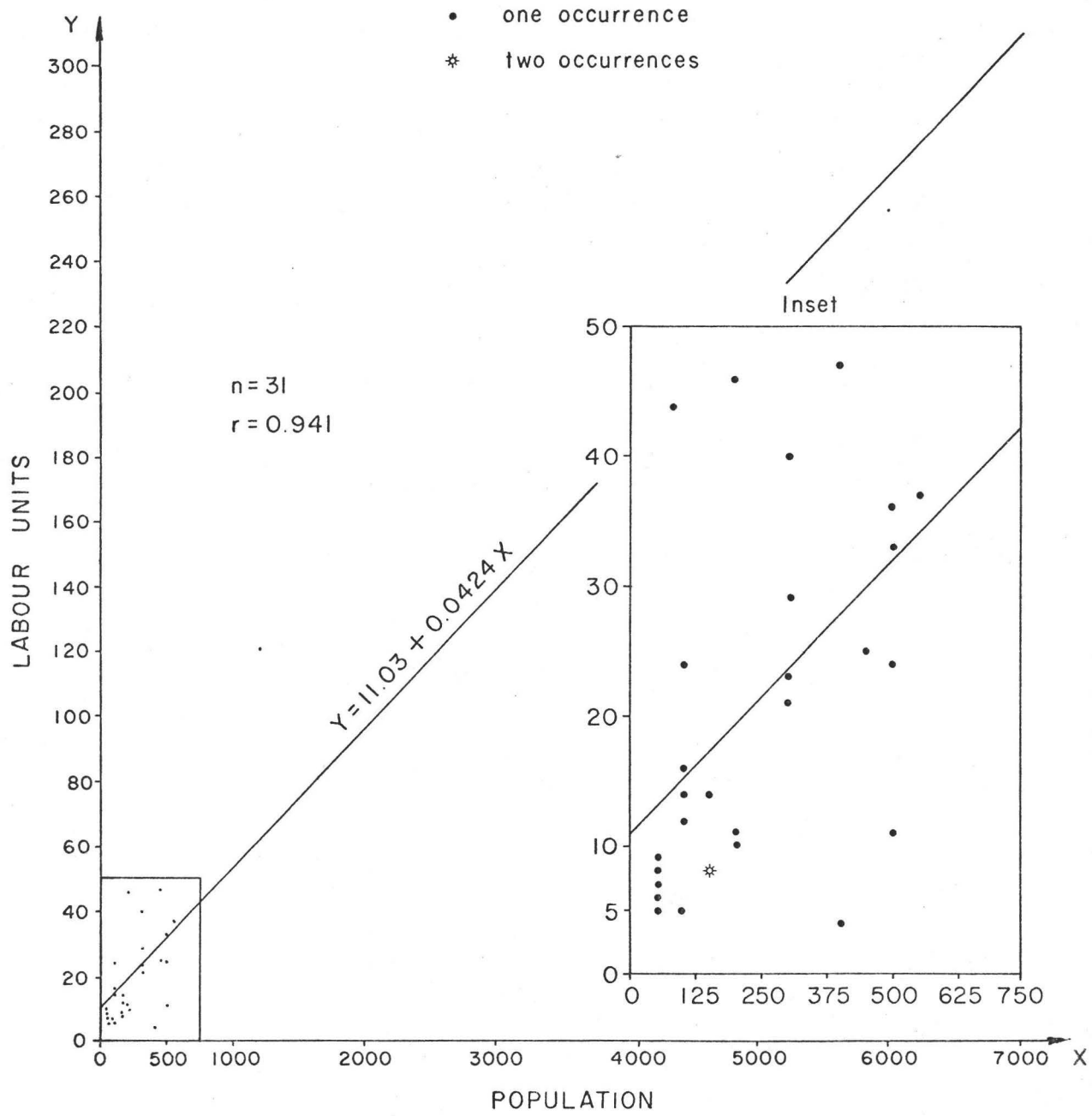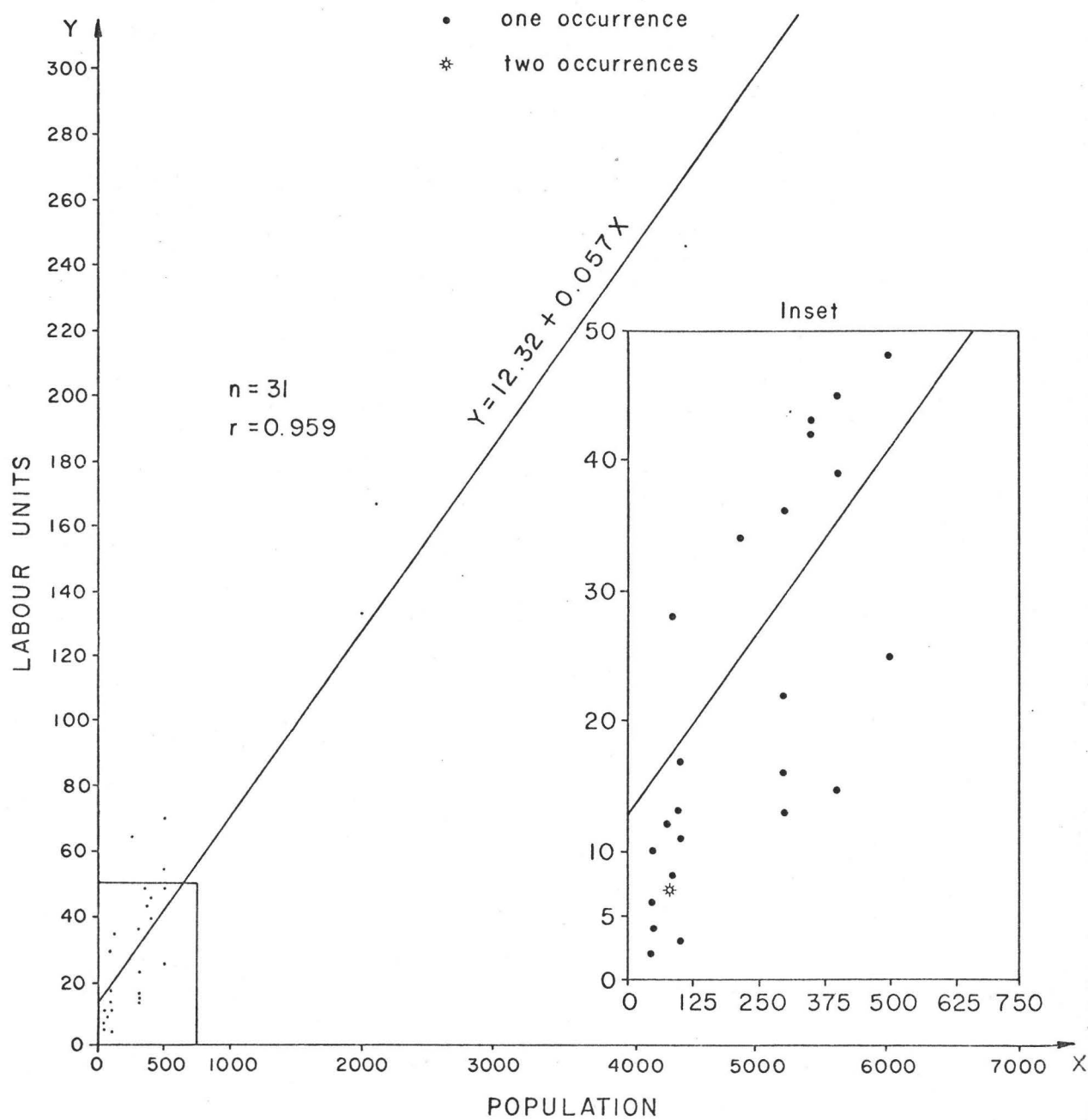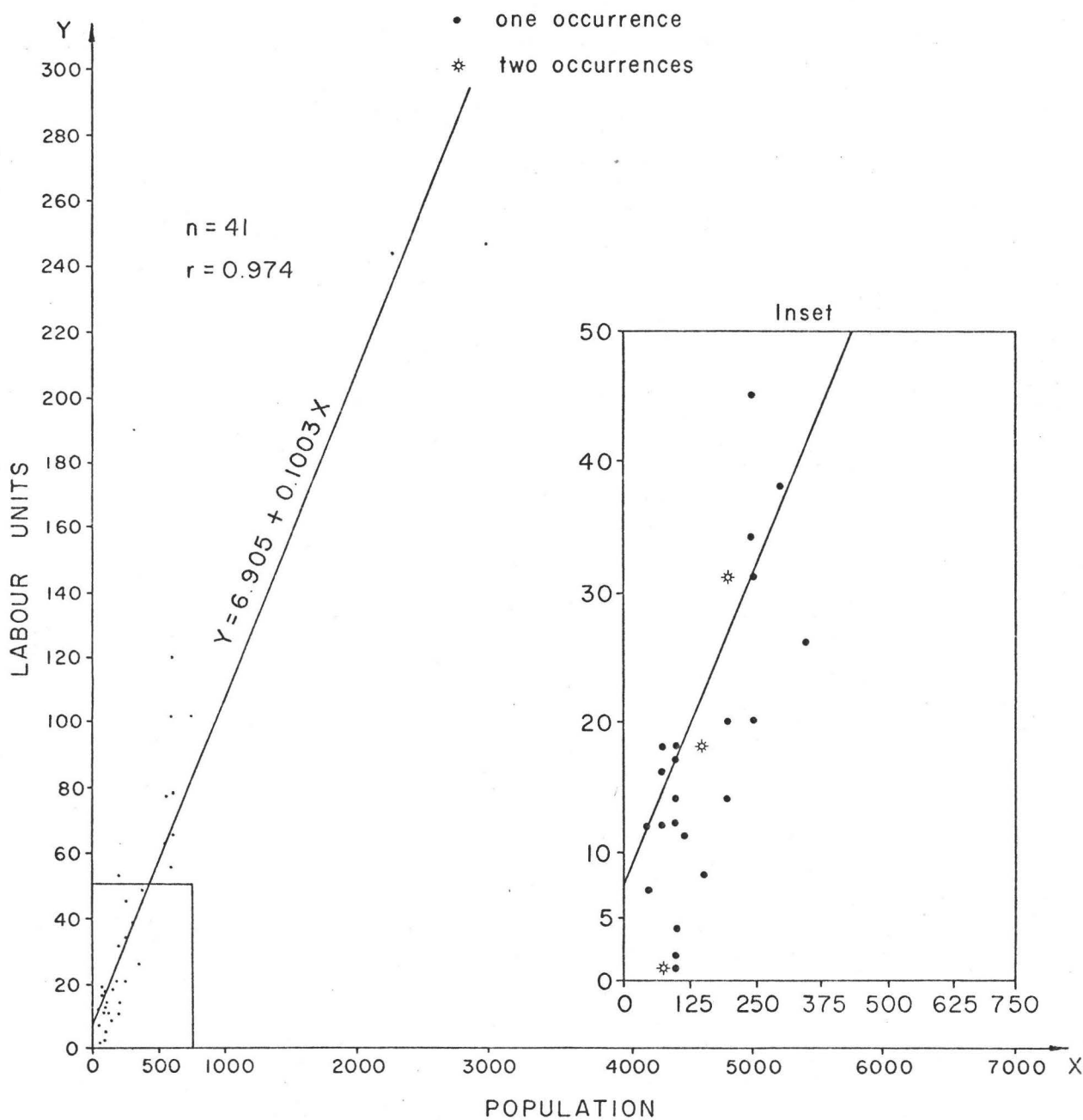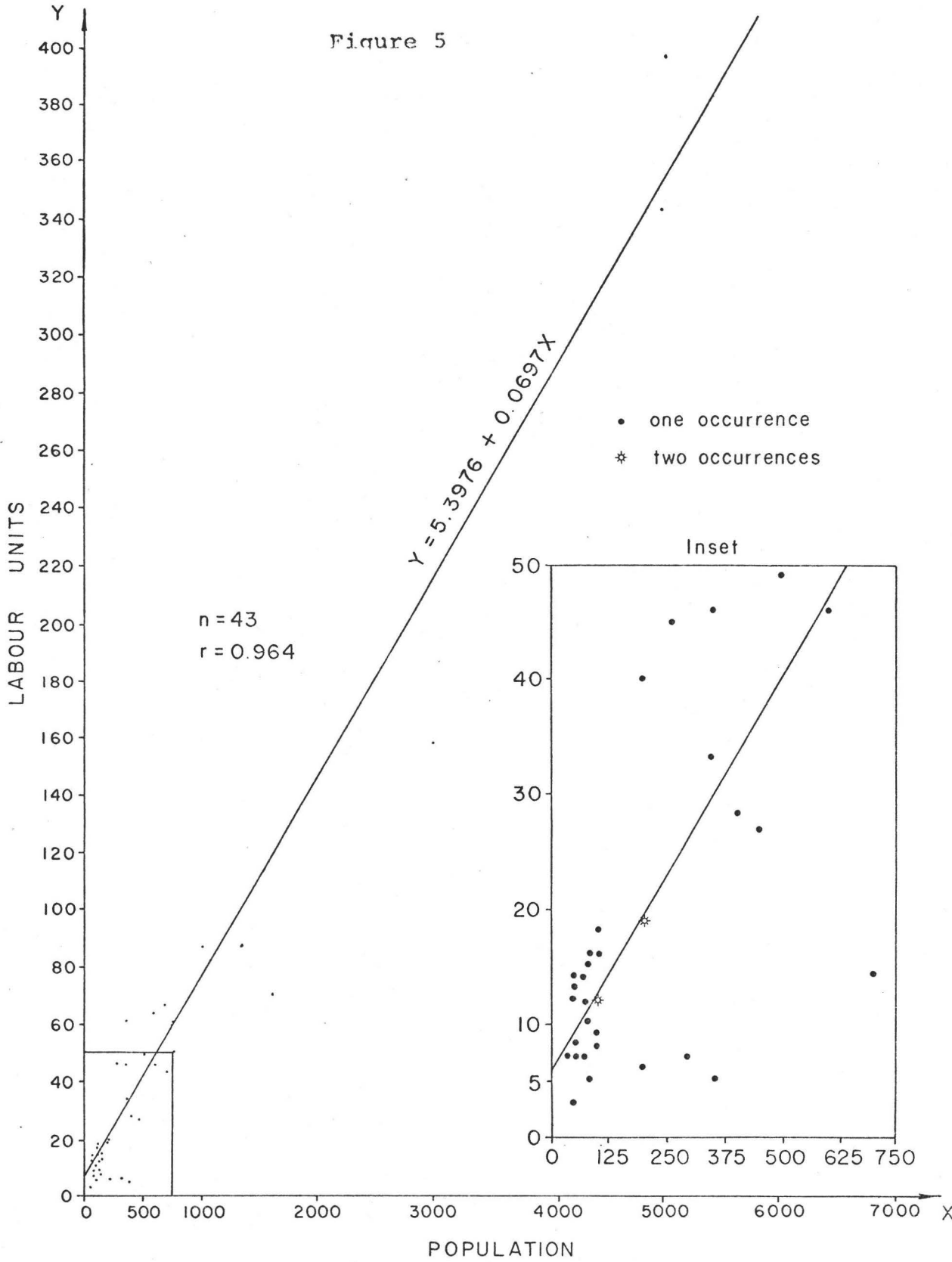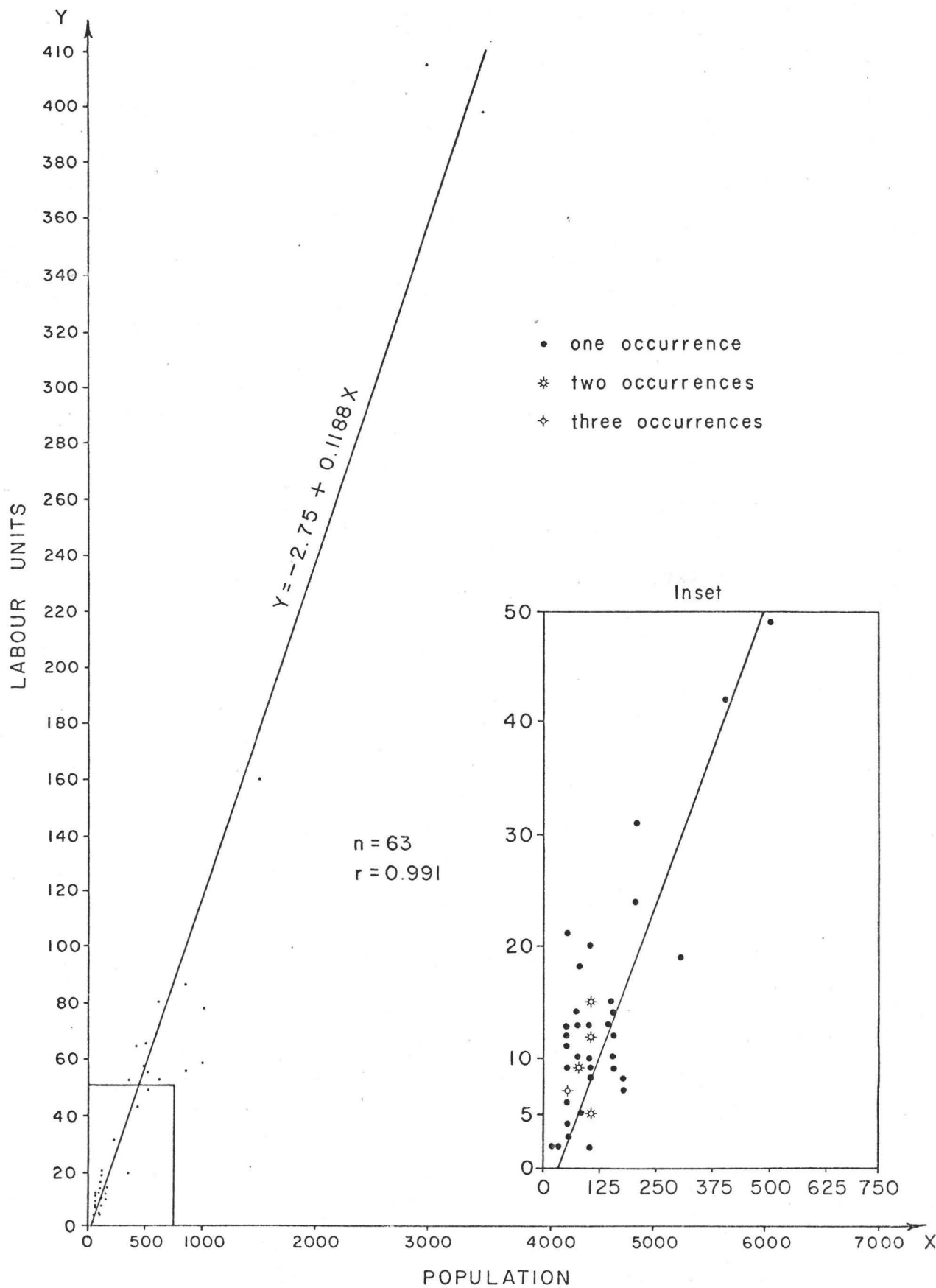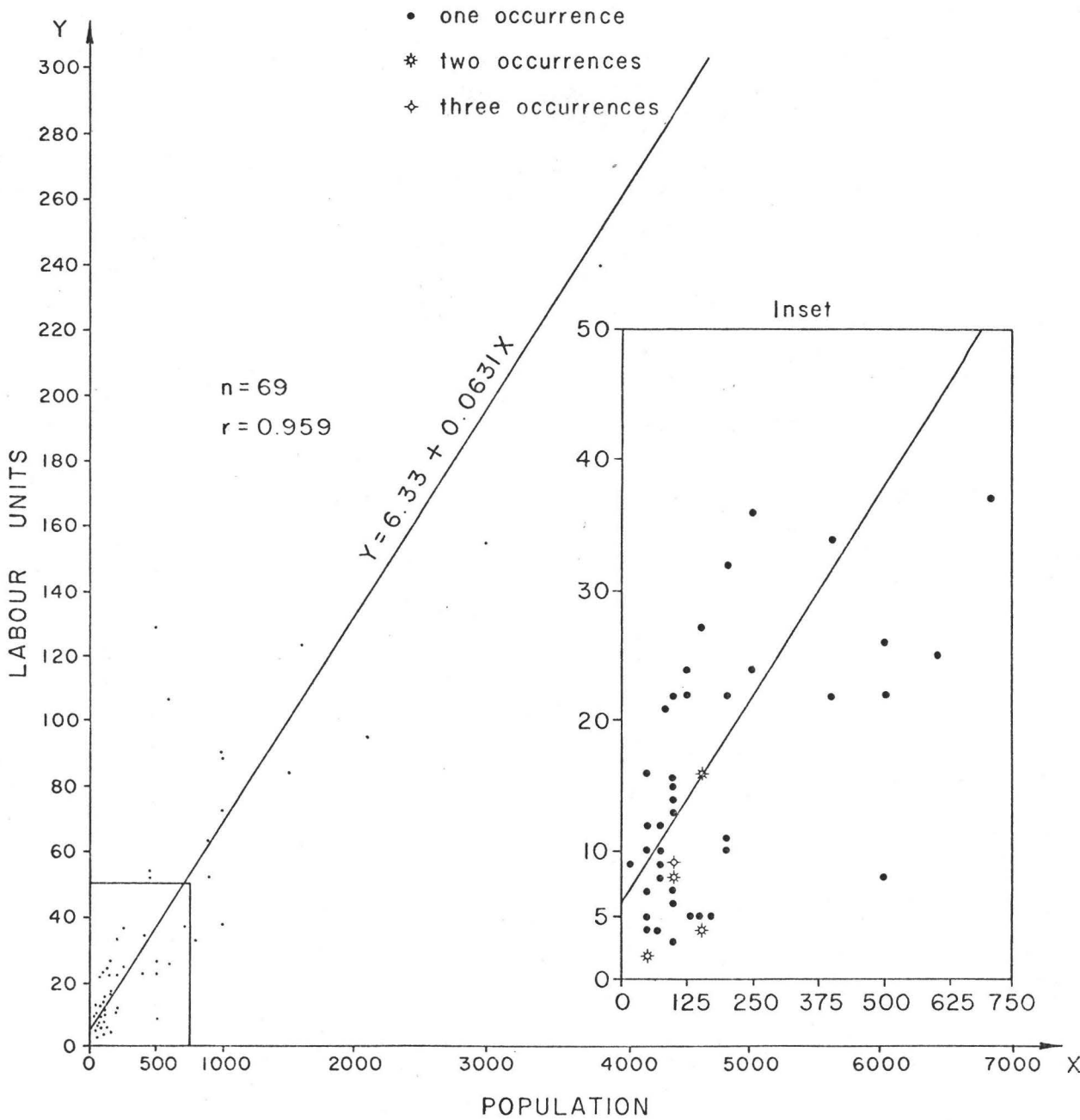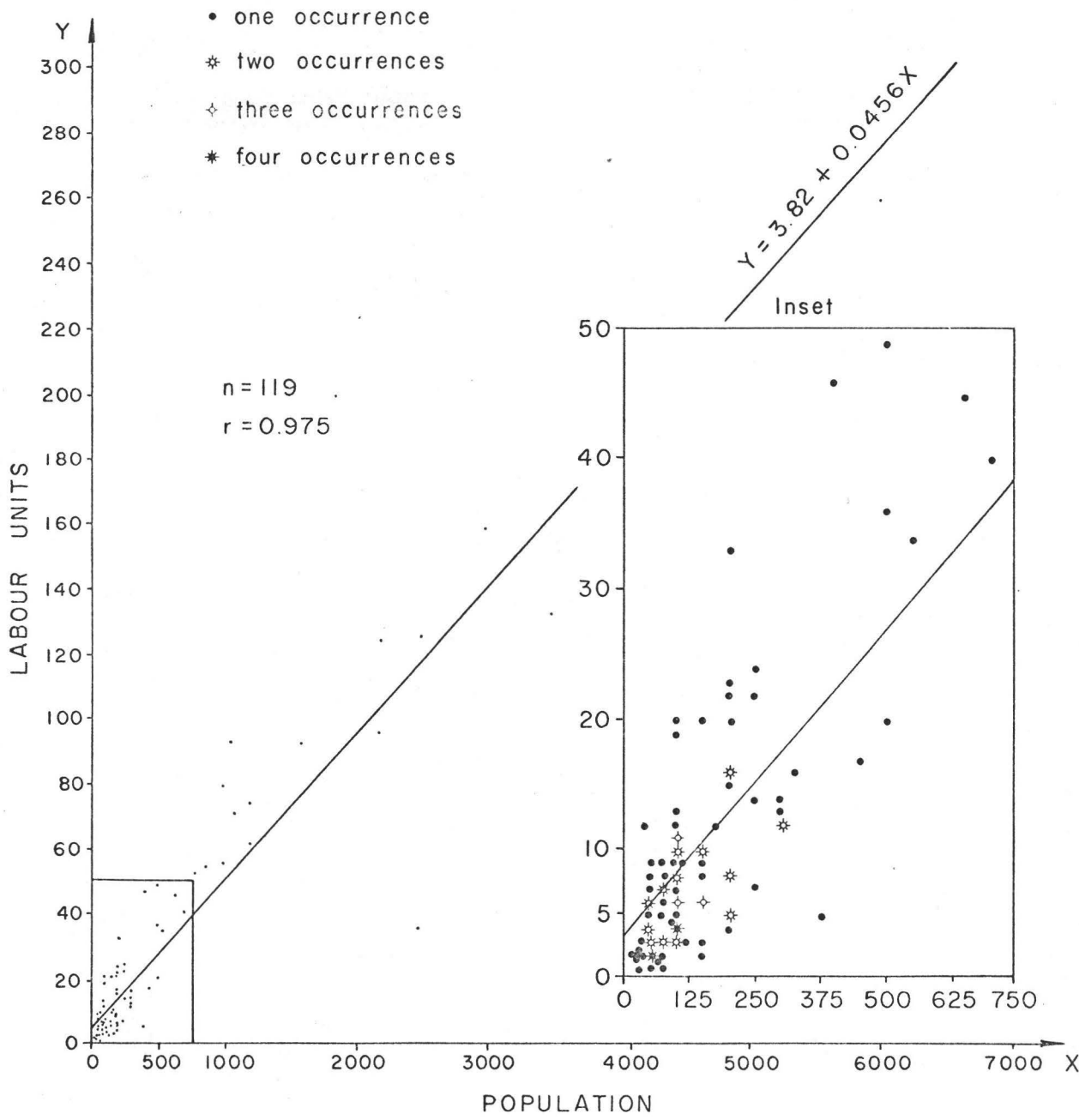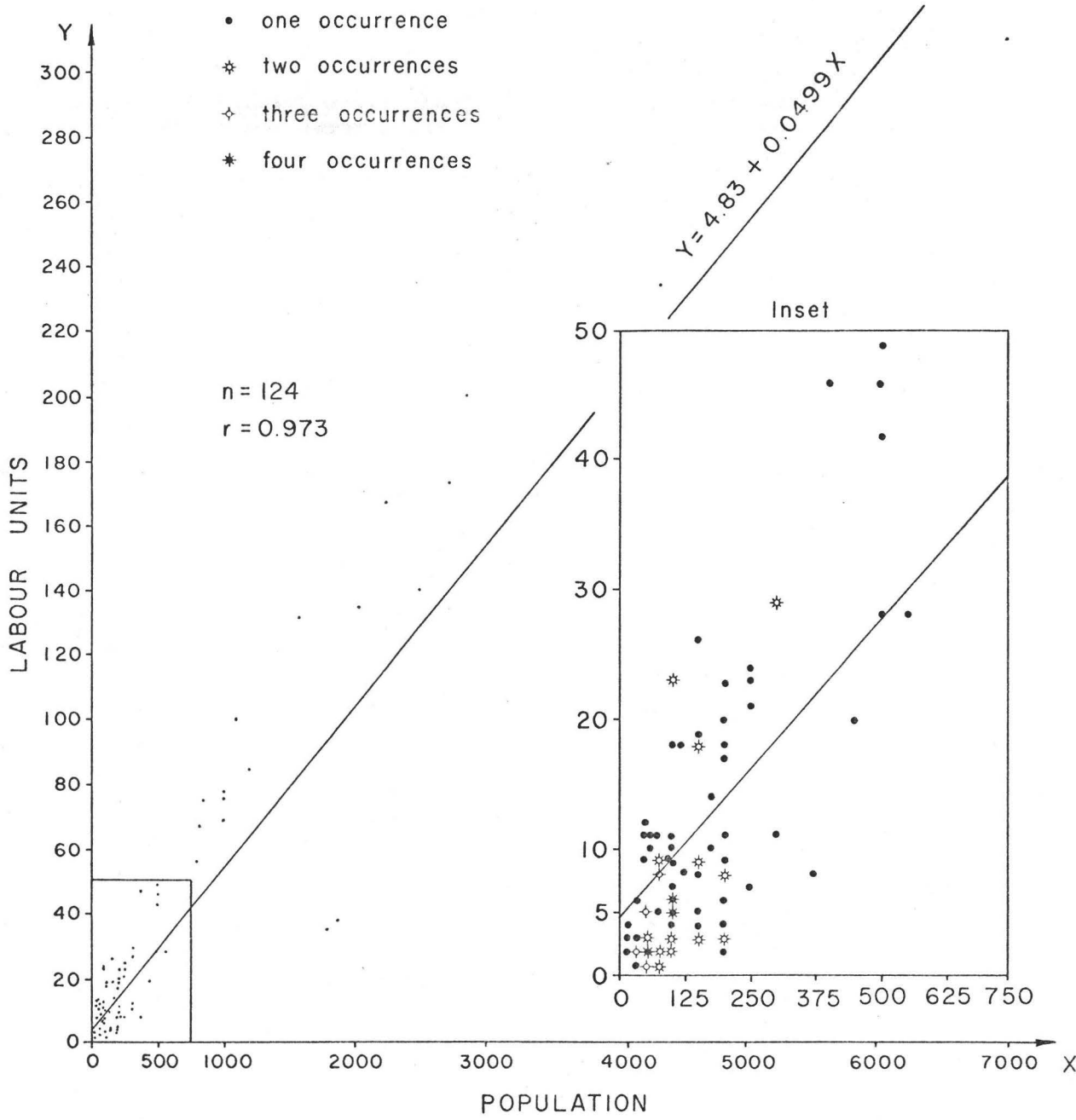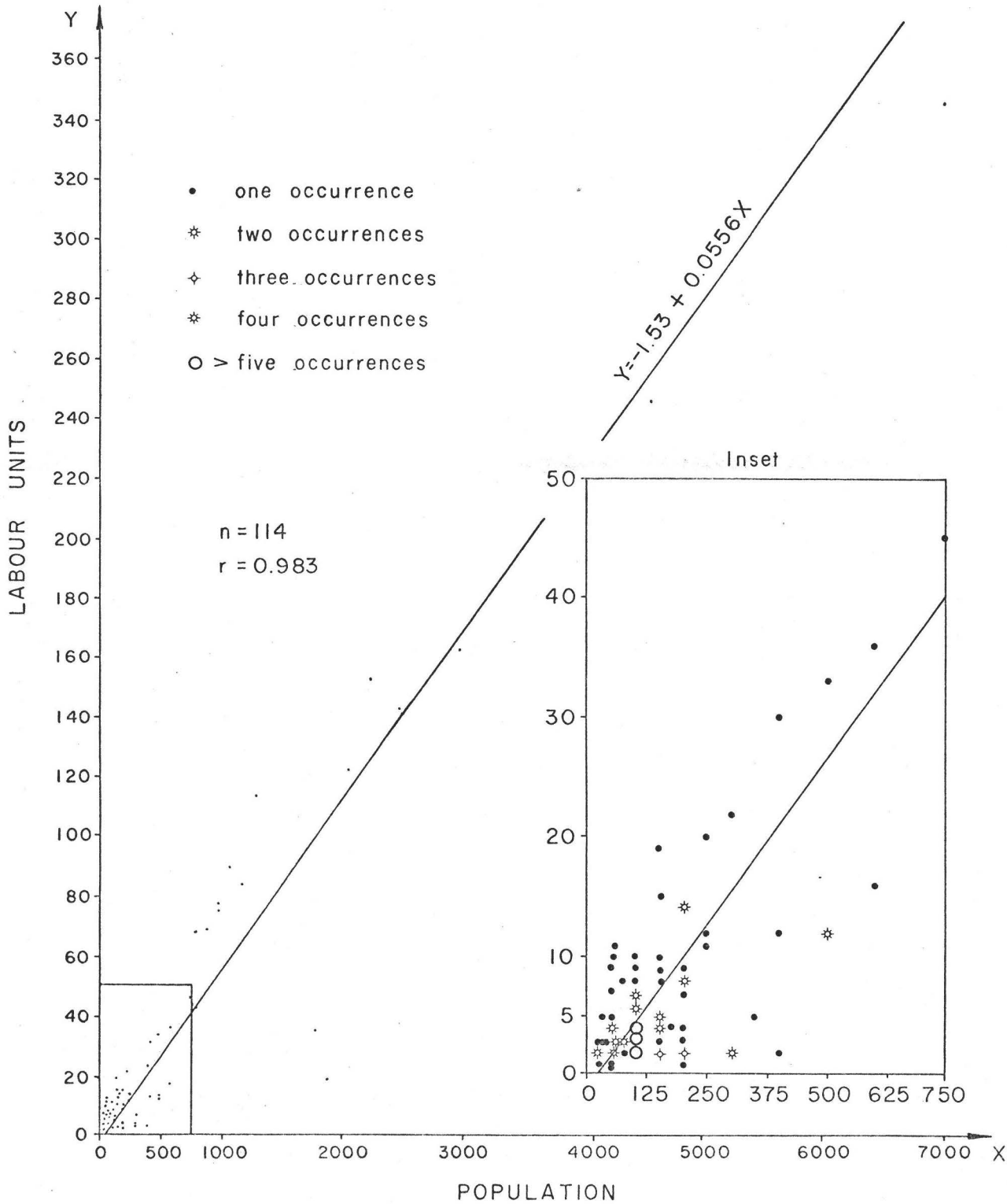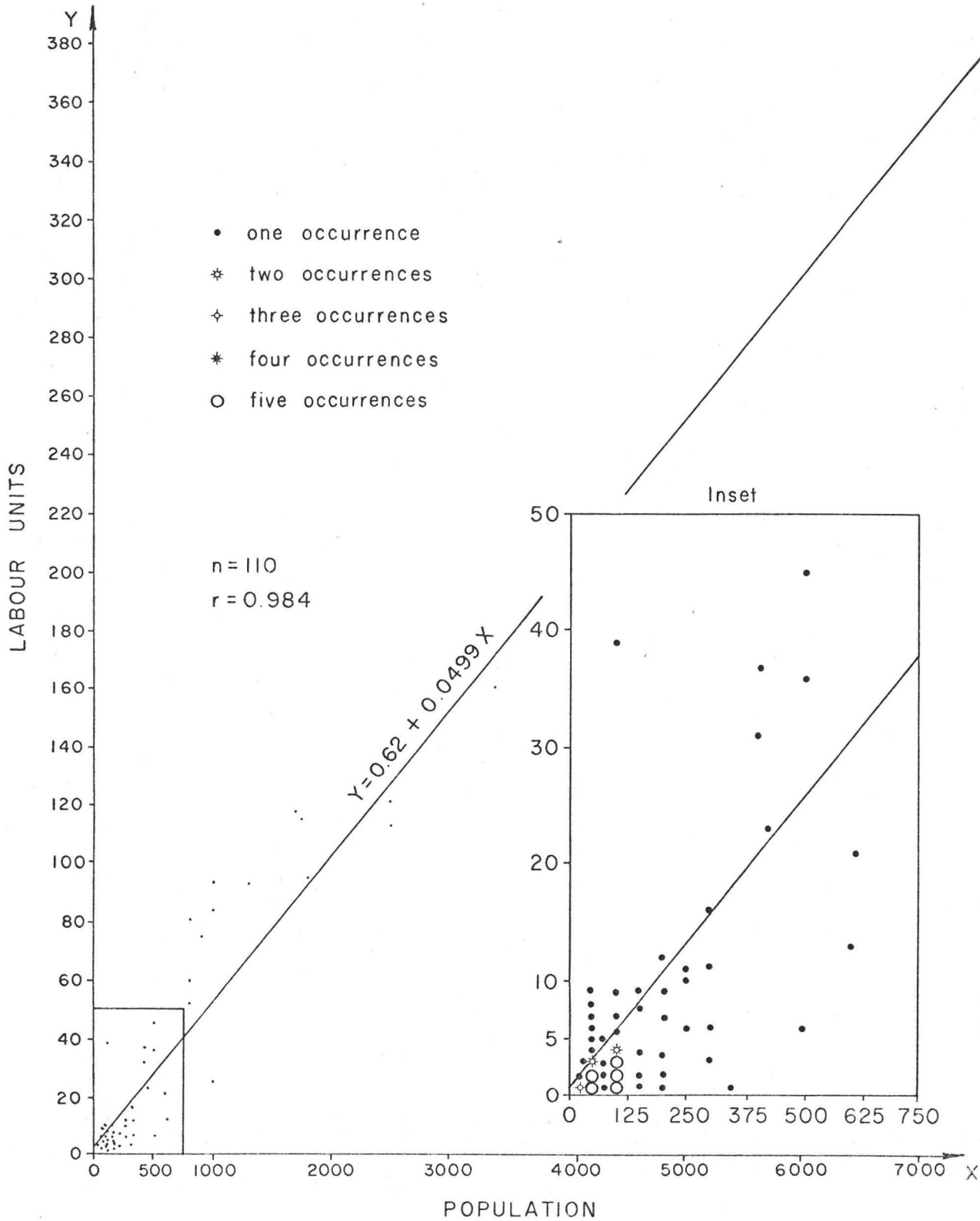
# 1907
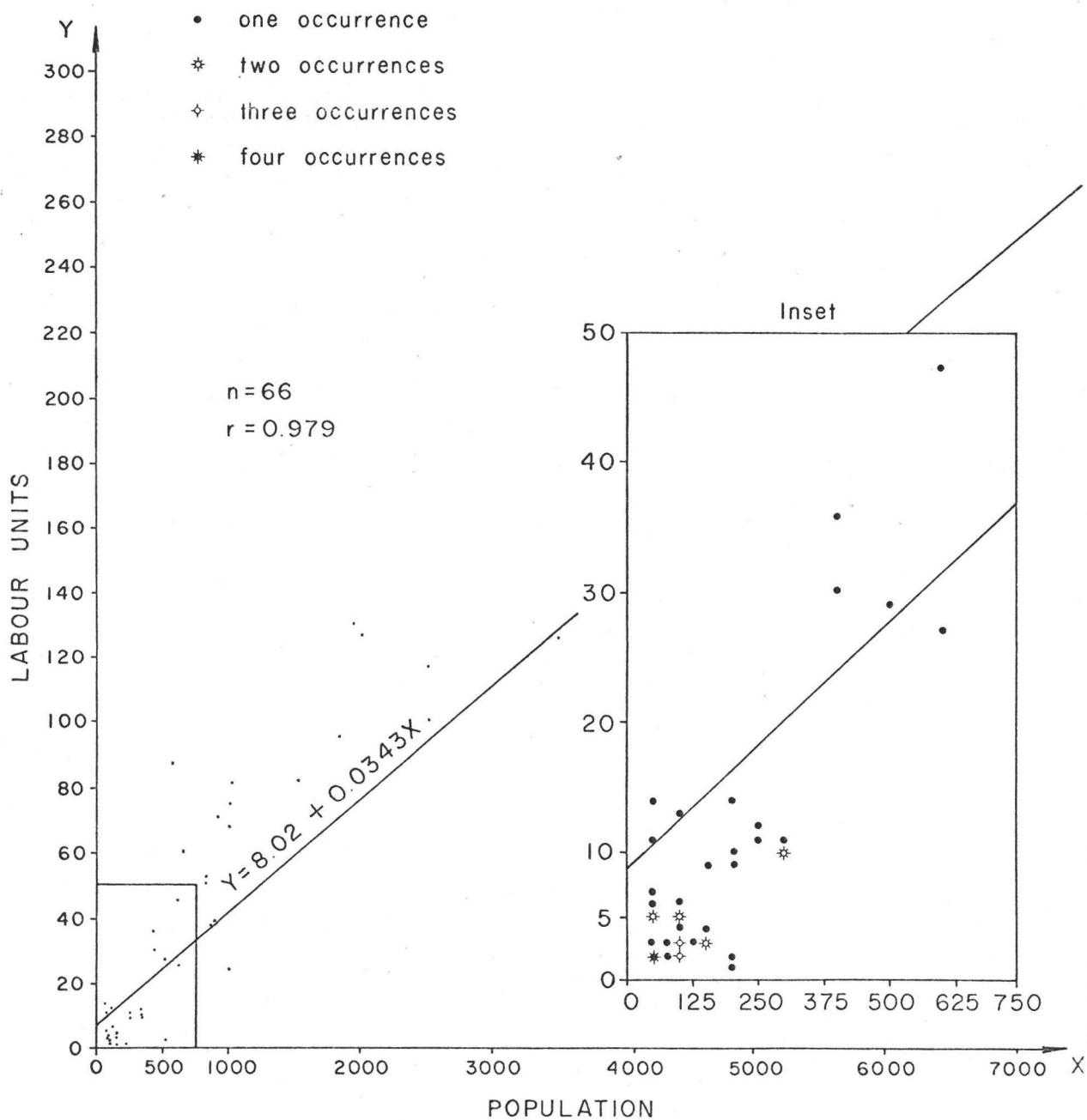
number of employees in that activity or possibly a replication of that same activity in another establishment -- both resulting in an increase in the number of labour units. For changes in population there is a certain lag before the impact is felt by the number of labour units and some adjustments have been made.

When the population-labour unit relationship is plotted on a scattergram for all places at each time period (figures 2 - 12), the large number of small places produce a high positively skewed distribution. Haggett has observed that most geographical distributions are non-normal and suggests the use of non-parametric or distribution-free statistical tests or the use of appropriate transformations to normalize observed data.[7]

Unfortunately, the use of non-parametric tests reduces all measurements to a rank-order scale which is of little interpretive value in this study. Logarithmic transformations fail to yield a normally distributed population. Therefore the data are analyzed in their non-normal form.

A best-fit regression line comparing the population: labour units relationship, was calculated for all available places at each time period. Linearity is presupposed in fitting this regression line, based on past findings that the population:functional units relationship is distinctly linear and labour units are a "weighted surrogate" of functional units. This decision to fit a linear regression line still permits the use of a curvilinear line if visual analysis reveals a non-linear trend.

---

[7]Peter Haggett, Locational Analysis in Human Geography, (London: E. Arnold, 1962), p. 287.

Two numerical values are derived in finding the best-fit regression line (y = a + bx). They are the slope or regression coefficient ('b') and the y-intercept value ('a'). The former indicates the rate of change or the change in y units corresponding with a change in one x unit. The latter expresses the value of y, when there are no x units present.

Note that when there is no population in a central place (and therefore no central place) there could be no labour units present. Yet, by taking the y-intercept value in its strictest mathematical interpretation, it would appear in 1857, for example, that there exist 11.03 labour units without any population to serve. This is impossible and illustrates a weakness that the regression line suffers at its extremes. However, to interpret the intercept value, as Thomas has,[8] in terms of a very small population ($\neq$ 0) supporting 11.03 labour units in 1857 offers little insight into changing centrality because of wide variations in the intercept values. Table 1 shows 'a' varying from a high of about 12 labour units in 1857 and 1864 (which seems quite unlikely just to support a very small population) to minus quantities in 1871 and 1898 (which is equally unrealistic in its strictest mathematical interpretation). There does not appear to be consistent variation in the intercept values relative to the number of observations, average population or labour unit size, correlation coefficient or slope coefficient. The intercept value 'a', therefore appears of little value in interpretation of changes in centrality.

The regression or slope coefficient, on the other hand, expresses the growth rate of y in response to x. The comparative rates of increase

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[8]Thomas (1961), op. cit., p. 13.

are plotted graphically in figure 13 and are also included as the
regression coefficient 'b' in Table 1.  Only 1866 and 1871 diverge
greatly from a norm of about 4-5 labour units per 100 population in
the 'average' central place.

Contrast this with Thomas' increase of  8.0 functional units
per 100 population and Stafford's increase of 4.2 functional units
per 100 population.  While their differences were "tentatively ex-
plained by variations in data collection procedure," such a justifica-
tion is not sufficient within these data (i.e. between different time
periods) nor when compared with other findings.

For example, within these findings, the high 1871 increase of
11.88 labour units per 100 population is open to question, when only
two years earlier, a much lower rate of 6.97 labour units per 100
population is present.  Slightly earlier, a similar situation occurs
with a high increase of 10.03 labour units per 100 population in 1866,
compared to 5.72 in 1864 and 6.97 in 1869.  Admittedly, the data sources
vary in each of these years, where 1864 is a Canada Directory, while
1866 is a tri-county directory for Essex, Kent and Lambton, and while
both 1869 and 1871 are provincial directories produced by different
publishers.  From these different data sources one might conclude that
1866, for example, has a higher rate of increase because of greater
accuracy in data collection over a much more restricted area.

Compared to those findings of Thomas and Stafford regarding
the functional unit:population relationship, some preliminary comments
can be made.  Although a "labour unit" approximates a "weighted"
functional unit, one can still expect considerable discrepancies where

Figure 13                                    61

# COMPARATIVE REGRESSION LINES
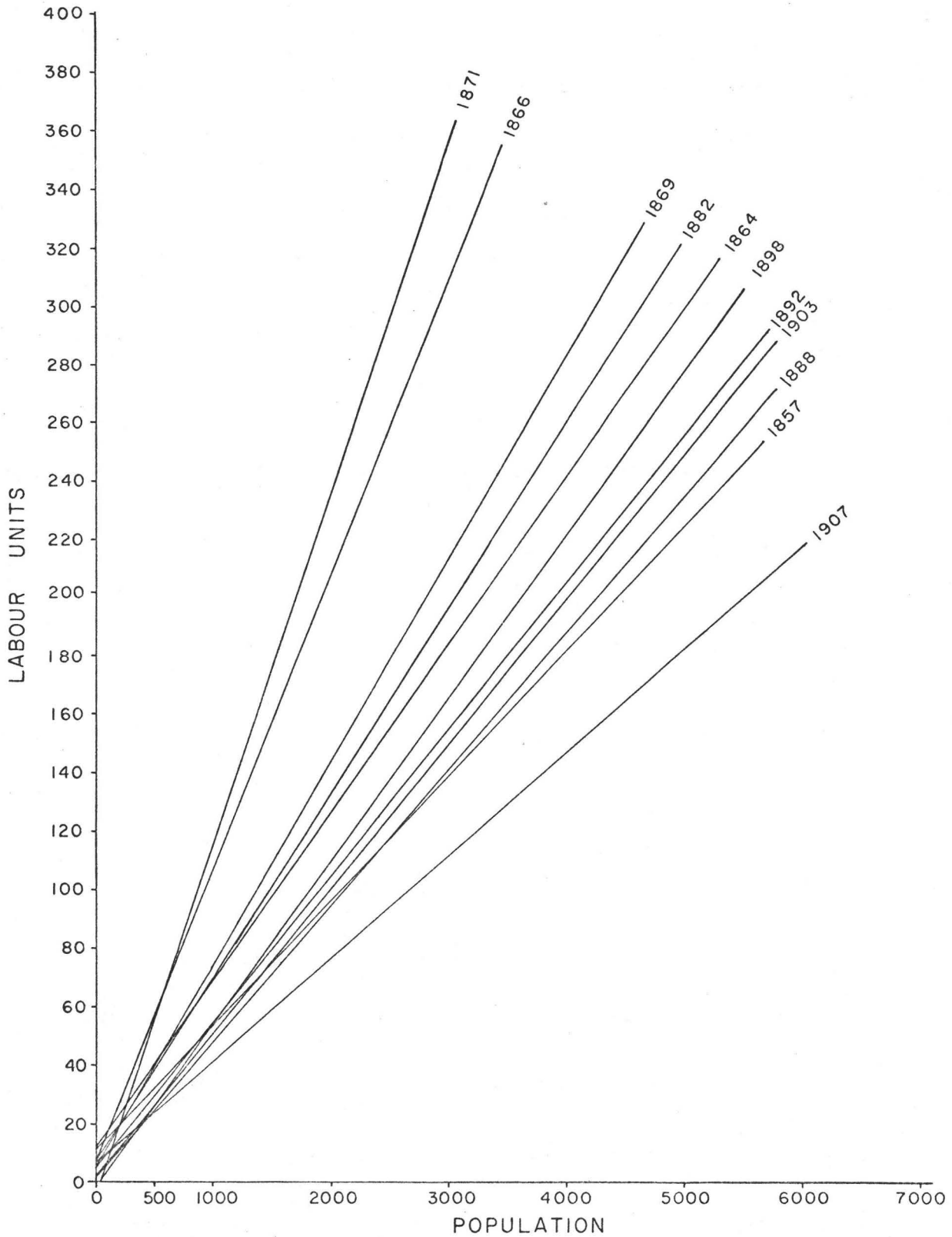
one labour unit (e.g. Mr. John Smith) can be carrying out three functional units (e.g. gas station attendant, general grocer and post-master). Therefore, in a small central place one might expect fewer labour units than functional units per unit of population, whereas in a larger place this relationship might change its proportions. Such conclusions, however, are neither supported nor rejected in this investigation because of an insufficient basis for comparison with past authors.

The general uniformity of the regression coefficient ('b') as listed in Table 1, can be used to suggest several possible hypotheses. Figure 13, showing all the regression lines for the eleven time periods, best illustrates this uniformity. Although the regression lines have the greatest interpretative value near the average population (about 500 people), it appears that the earlier observations have a steeper slope while those later ones (1888-1903) have dropped to a lower, but even more regular, position. The last observation (1907) has again dropped even more significantly from the earlier clustering.

How may these changes in slope, and therefore changes in the average centrality of all centres through time, be interpreted? Two interrelated processes, may be operative.

Causing this decline in slope through time, there may be fewer labour units required to serve the same population. This could be attributed to an intensification of manpower in the central or service activities. Certainly it has been common knowledge that the primary industries (farming, fishing, forestry, etc.) and the secondary industries (manufacturing in particular) have both undergone consider-

able reductions in manpower while increasing productivity. It would

seem that central and service activities (approximately the same as

tertiary industries) have undergone similar reductions in manpower

requirements.

For example, figure 13 may be reconstructed as follows:

```
1866 - 1000 people served by about 107 labour units.
1882 - 1000    "      "     "    "    69    "      "  .
1898 - 1000    "      "     "    "    54    "      "  .
1907 - 1000    "      "     "    "    42    "      "  .
```
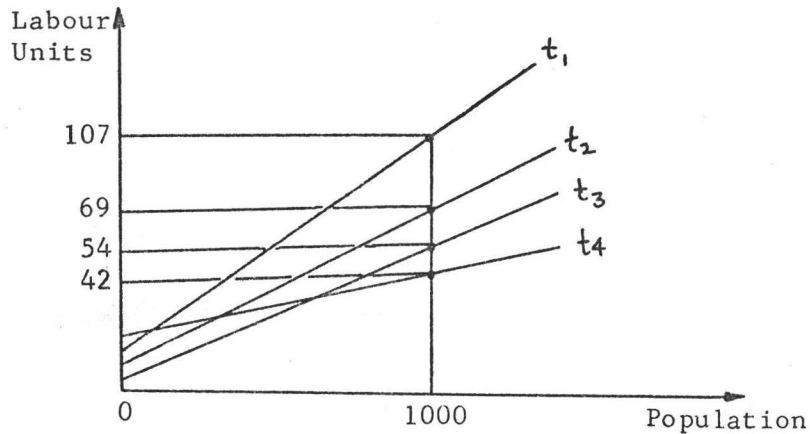


Secondly, this reduction in labour units for the same size

population has further implications. Through increased automation

and technological development more people were able to make use of the

same number of labour units. In this particular study area and during

the period in question, the railroad, the regular pattern of concession

roads, the innovation of rural mail delivery and the increase in per-

sonal wealth particularly attributed to the discovery of petroleum,

were a few of the developments that changed the density of labour units

relative to population. This second process would occur as follows,

again from figure 13:

```
1866 - 50 labour units served    430 people.
1882 - 50    "       "      "     700   "   .
1898 - 50    "       "      "     925   "   .
1907 - 50    "       "      "   1,250   "   .
```
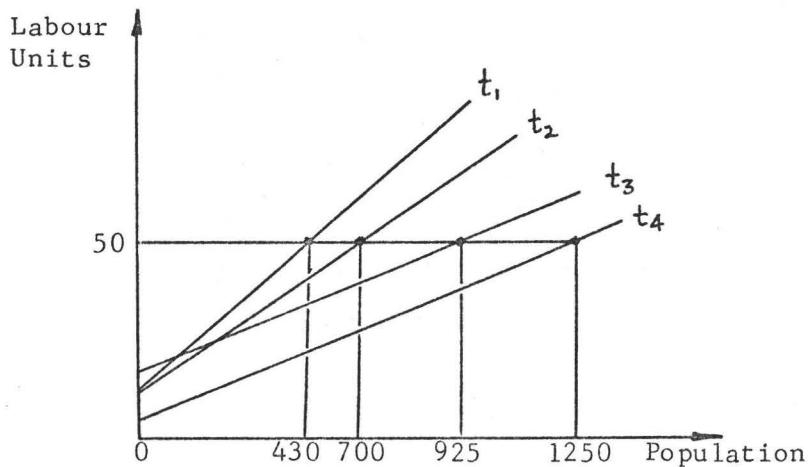


Essentially, there are not two processes but only one with two explanations of how the change occurred -- the former dependent on labour intensification and the latter dependent on an expansion of population served.

Recalling that the regression line is simply an expression of the average change in centrality of various size centres at one point in time, it has therefore been shown that centrality has declined through time for similar sized centres. This decline is neither regular nor consistent, and although not tested rigorously, it is expected that these temporal changes in centrality in all sizes of centres are related to definite events like the coming of the railroad, the establishment of a post office, the discovery of petroleum and to distance away from similar occurrences.

Of slightly less interpretative importance, though valued highly by past authors, are the results of the correlation analysis. The correlation coefficient 'r' shows how well the data fit the regression

line or, in other words, how tight or compact the points cluster around the regression line. It is independent of the scales of measurement of both x and y. Though not entirely unexpected in light of past results relating population and functional units, functions and establishments, the correlation coefficients are all very high. Table 1 lists 'r' as varying from 0.94 to 0.99. There does not appear to be any regular pattern of change. All of the values for each time period suffer statistically from a non-normal population sample. Many small places increase the correlation coefficient because of a small deviation from the regression line. Nevertheless, as explained earlier when transformation to normal data was considered, the problem of non-normality is not felt to be serious. In an attempt to establish how closely population expresses change in the functional base of small urban places, many authors[9] over-stress the high correlation between population and establishments, functions and functional units as out-lined in chapter 2. Thomas, King and Stafford were all dealing with non-normal samples and yet, were no less emphatic of their results. It is little wonder that a higher 'r' was found in this study considering the changes toward higher prediction suggested by Davies and O'Farrell.[10]

Some question arises as to whether such a high correlation is not too high and therefore exposing a correlation of variables that are essentially synonymous. With a knowledge of the basic research carried out on this subject as outlined in chapter 2, and the place

[9]Thomas (1961), Stafford (1963), King (1963) and Berry and Garrison (1958), op. cit.

[10]Davies and O'Farrell, op. cit.

of this research as an extension of that already in existence, it seems that such a statement is invalid. Admittedly the two variables are very interdependent, but small changes in their relationship are highly significant in illustrating changes in centrality.

Some general observations are necessary regarding Table 1. The average population ($\bar{x}$) fluctuates fairly consistently around 450-500, quite similar to Thomas' average population of 462. But this average population has remained fairly constant (until 1907), while number of places (n) has changed markedly. In the last time period (1907) the average population rose sharply coupled with a sharp drop in the number of places. A return to the original data in appendix II reveals that it was mostly minimal settlements that were phased out, to account for the sharp drop in number of places and the rapid ascent of average population.

To this point in chapter 5, the changes in the average centrality of all places within Kent and Lambton counties (for which data were complete) have been analyzed at eleven points in time. In general, a best-fit regression line describes this average centrality for each time period and a description of these regression lines and their appropriateness to the data, points to a decline in average centrality through time.

But what of changes in centrality in places of 100, 500, 1000 or 3000 people? Do all sizes of places show a decline in centrality through time? Do labour units show a slight lag in adjusting to population or are the time intervals chosen not adequate for presenting this?

To observe some of these changes in specific sizes of small urban places, several places in each size class have been picked, not

randomly, but quite selectively in terms of the most complete temporal coverage available. An alternative, of grouping all places in certain size classes, was rejected because of the crossing of "size-class boundaries" through time. For example, Wallaceburg, the only centre with data in all thirteen time intervals (including 1846 and 1851) begins in the 50-100 class, then maintains a population of about 500-600 for seven consecutive time intervals and then stays at the 3000 population level for the remaining five time intervals. Therefore, no assessment can be made of changes in centrality in certain size centres.

The average population $(\bar{x})$ and the average number of labour units $(\bar{y})$, shown in Table 1, are plotted as a ratio against time (see figure 14). Time, on the x-axis, is scaled so that the intervals between each time period are proportional to the number of years between each directory used.

Nevertheless, the earlier notion that centrality in general has declined over time is here substantiated. The best-fit regression line and the correlation coefficient must be viewed rather cautiously in light of the lack of independent observations that plague correlation and regression analysis in a time series study. A positively-sloping linear trend is graphically obvious and when the ratio of population to labour units increases, then centrality lessens.

The change in the population:labour units ratio, as described in greater detail at the end of chapter 4, is, unfortunately, overly sensitive to some changes in labour units in particular. Figures 15-18 best illustrate this point. For example, in figure 15, Dawn Mills maintains a low ratio around 5.9, 6.5, 8.3, 4.2 and 7.5, but then soars

Figure 14                                    68

# CHANGES IN CENTRALITY
# SHOWN BY RATIO OF AVERAGE
# POPULATION – AVERAGE LABOUR UNITS
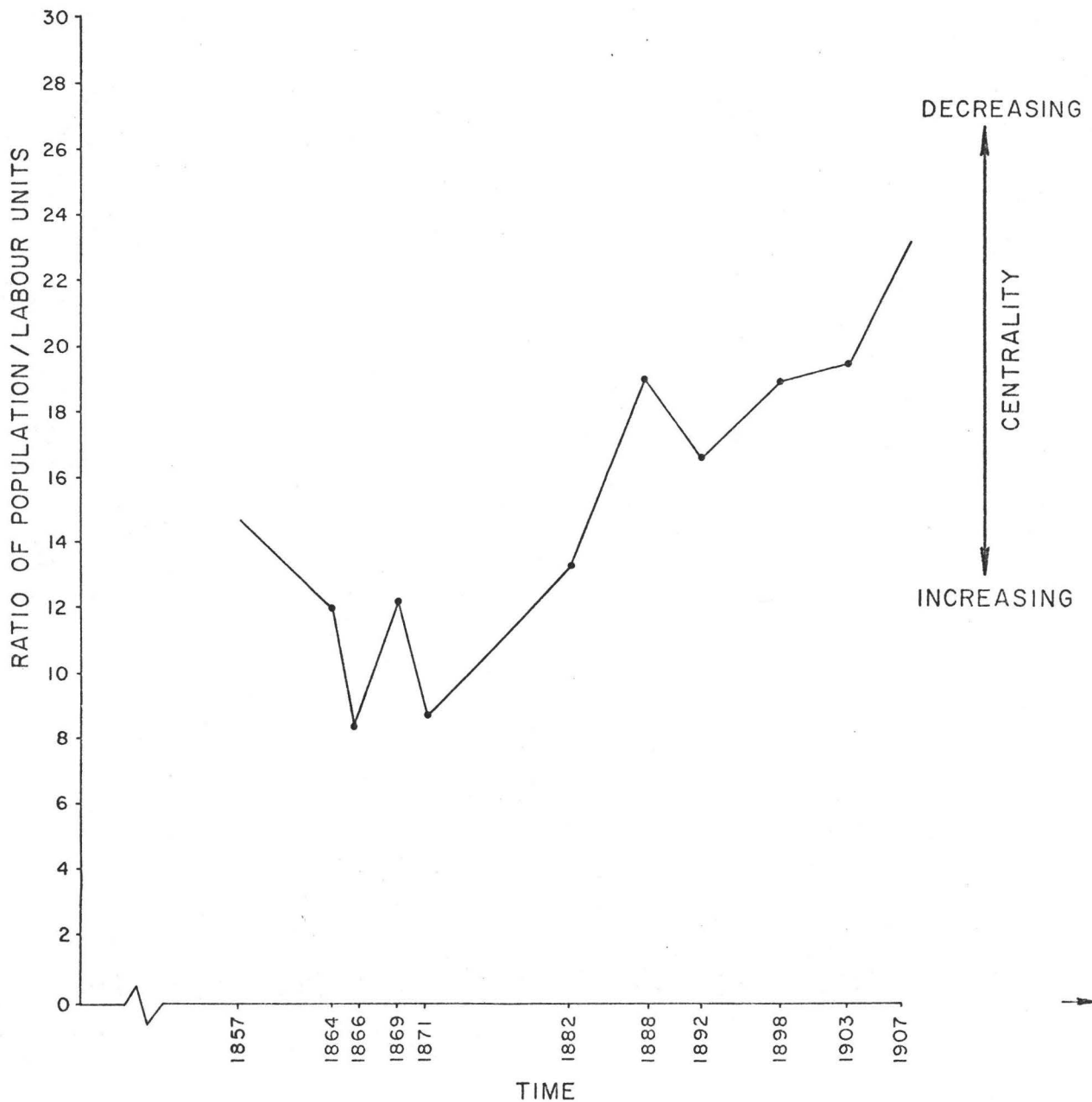
up to 25.0, 20.0, 33.3, 100.0 and 50.0. This change is not due to population (which stays relatively constant around 75-100-200), but rather to a very marked drop in the number of labour units. Admittedly, much of this problem of high ratios in small places with a bare minimum of labour units, could be alleviated by raising the minimum number of labour units required for inclusion as a small urban place. But similar fluctuations occur with Duart and Corunna in the 100-500 class and with Morpeth (500-1000), Watford (more than 1000) and Blenheim (more than 1000). In the case of Blenheim, the "apparent" fluctuation stems from the 1892 data of 1800 population with only 35 labour units. In view of the preceding and succeeding data, it seems entirely possible that such a fluctuation could be attributed to inaccuracies in the data. Duart takes one very noticeable jump in 1898 where, although population remains stable around 300, labour units plummet from twenty-three in 1892, to two in 1898 and back up to sixteen in 1903. Again, unless these drastic changes can be coupled with some very evident historical incidences, it seems quite likely that the major fluctuations are "explained" by data inaccuracies.

Visually comparing figure 14 with figures 15-18, reveals some differences. The smallest places (figure 15) show a similarly low ratio and therefore high centrality in the period from c.1866 to c.1882. Although the average is also at its lowest ratio during a roughly similar time period (figure 14), there appears to be greater fluctuation of the ratio as the size of centre increases.

With the exception of several extreme divergences attributed earlier to data weaknesses, each "class" reveals several properties.

Figure 15                                    76

# CHANGE IN CENTRALITY OF INDIVIDUAL PLACES IN 50-100 POPULATION SIZE-CLASS



DAWN MILLS
DUART
KENT BRIDGE
BABY'S POINT
CLEARVILLE

RATIO OF POPULATION / LABOUR UNITS

TIME

1857   1864 1866 1869 1871   1882   1888   1892   1898   1903   1907

Figure 16                                                        71
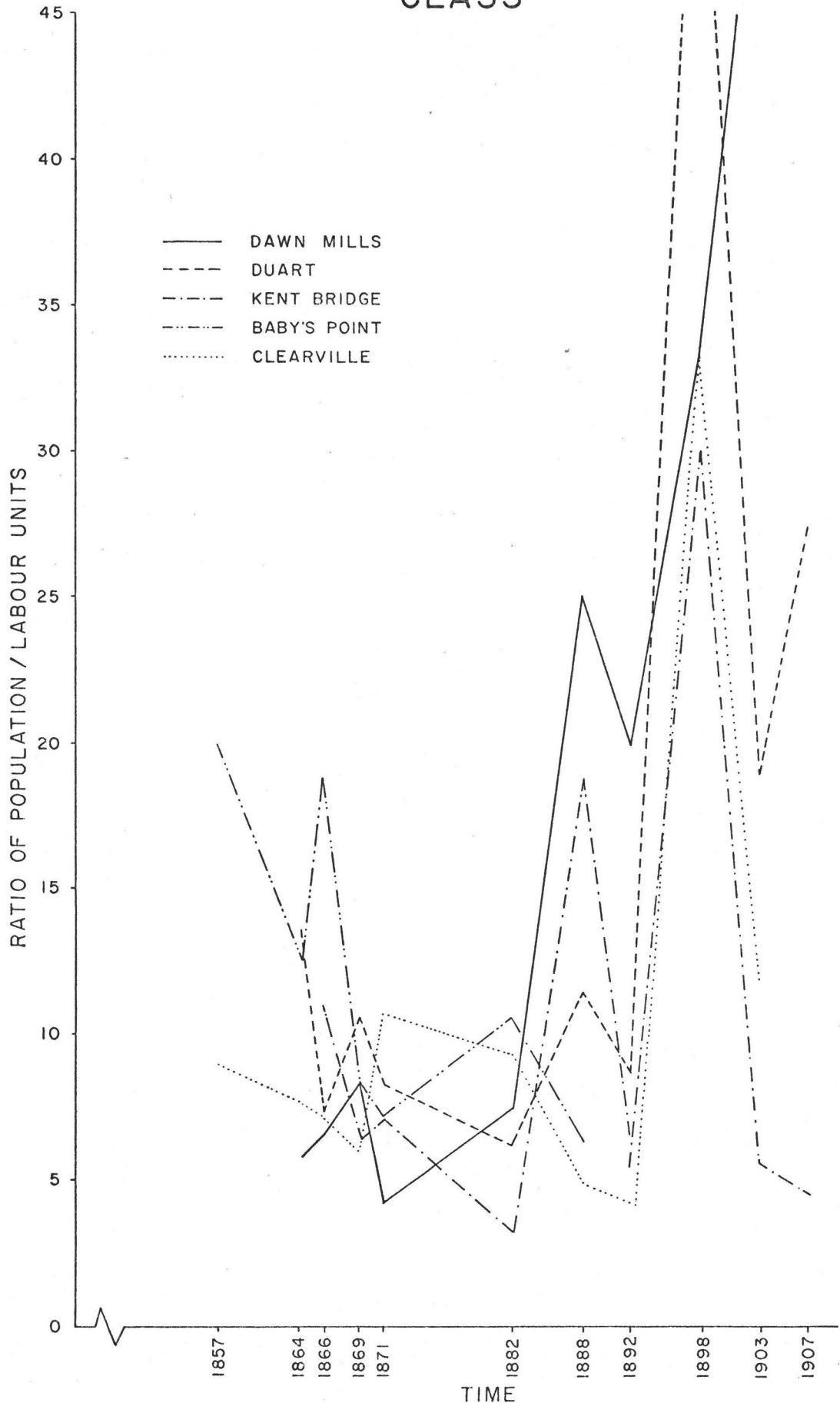
# CHANGE IN CENTRALITY OF INDIVIDUAL PLACES IN 100-500 POPULATION SIZE-CLASS



DUART

CORUNNA

SOMBRA

FLORENCE

HIGHGATE

RATIO OF POPULATION / LABOUR UNITS

TIME
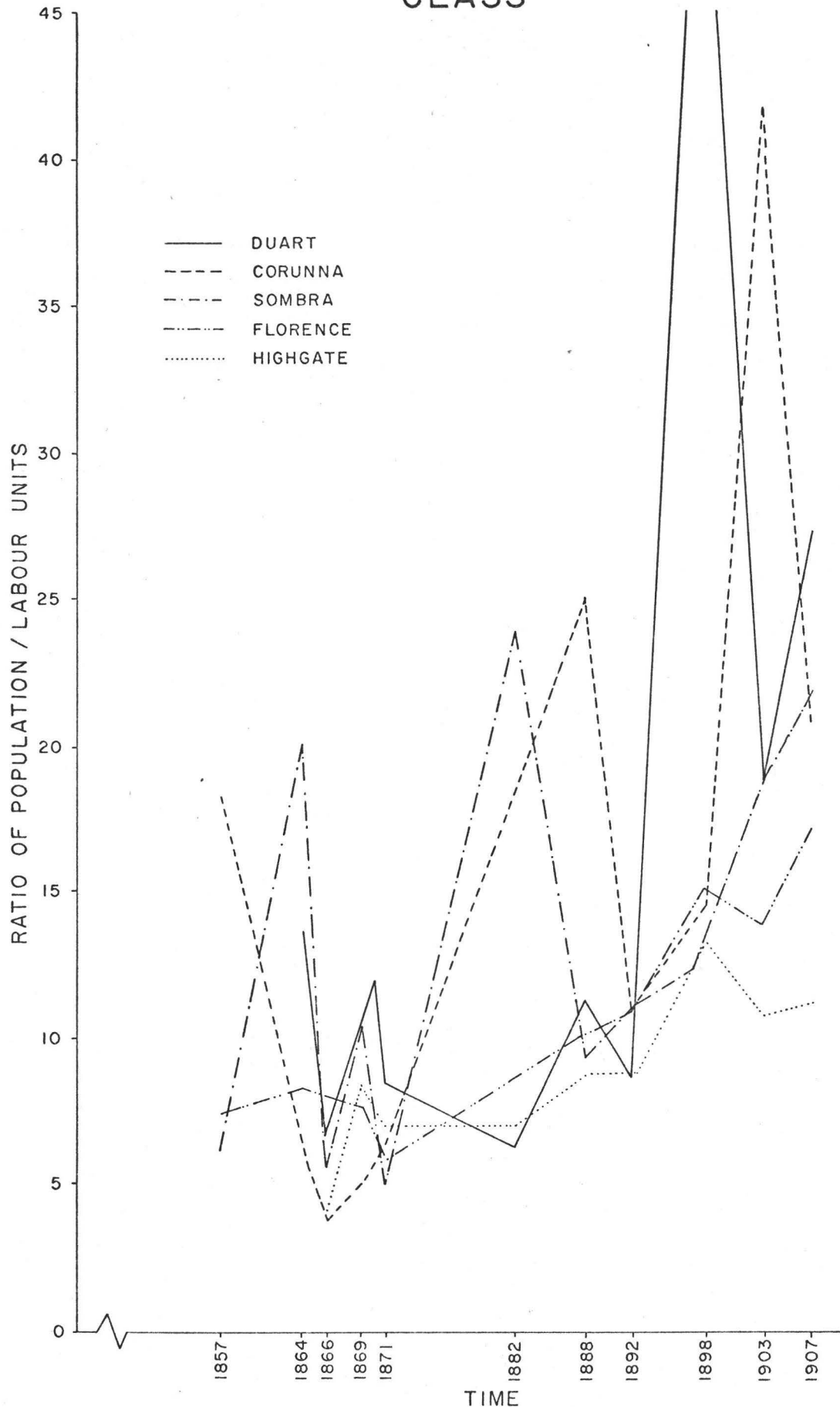
Figure 17

# CHANGE IN CENTRALITY OF INDIVIDUAL PLACES IN 500-1000 POPULATION SIZE-CLASS
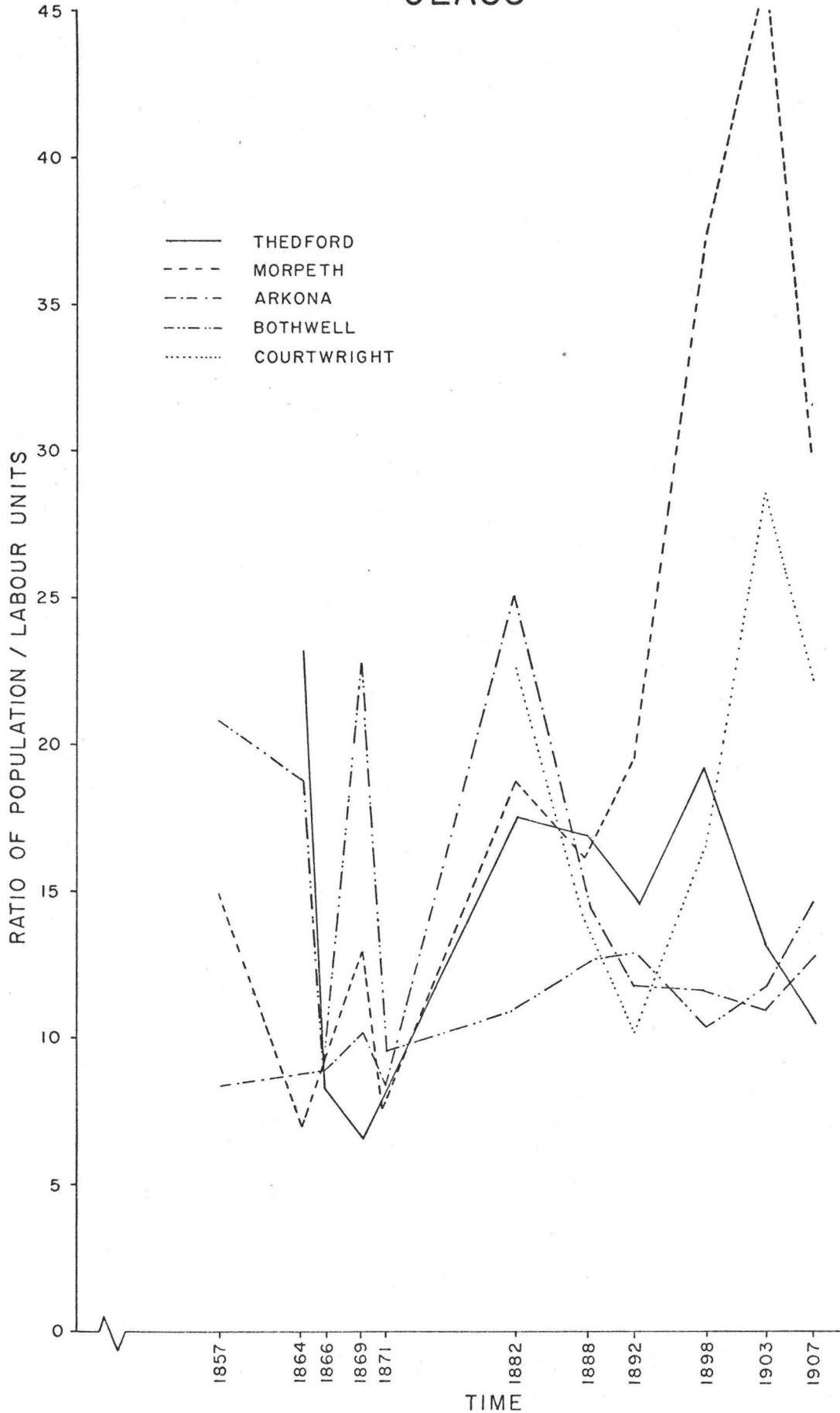


Legend:
- THEDFORD
- MORPETH
- ARKONA
- BOTHWELL
- COURTWRIGHT

Y-axis: RATIO OF POPULATION / LABOUR UNITS

X-axis: TIME (1857, 1864, 1866, 1869, 1871, 1882, 1888, 1892, 1898, 1903, 1907)

Figure 18                                              73

# CHANGE IN CENTRALITY OF INDIVIDUAL
## PLACES IN >1OOO POPULATION SIZE –
## CLASS



RATIO OF POPULATION / LABOUR UNITS

WALLACEBURG
WATFORD
BLENHEIM
FOREST
PETROLEA

45

40

35

30

25

20

15

10

5

0

1857  1864  1866  1869  1871  1882  1888  1892  1898  1903  1907

TIME

Figure 15 (the smallest size centres) has a high amplitude in most cases from 1888 to 1907, whereas figure 16 (100-500 class) is more compact than figure 15 in the 1888-1907 range, but scattered more widely over the entire range from c.1851-1907. Figure 17 (500-1000) appears to have a somewhat lower amplitude than figure 16, with the ratios of 1892-1907 even more closely packed than in figure 16 (Morpeth and Courtright excluded). Figure 20 (greater than 1000) is the most uniform in its fluctuations with only Watford and Blenheim, as mentioned earlier, diverging in two instances. Note how the amplitude in general is very similar to that of figure 14 showing the average changes. The slope of the regression lines in figure 18, are the most consistently rising, indicating the most marked tendency for a decline in centrality.

Although calculated for each place, the correlation and regression data are not used in any interpretation of results within specific sizes of urban places. The limitations (particularly regarding independence) of these techniques in a time series study are felt to be sufficient to delete their use.

Therefore, any observations made of particular sizes of small urban places are tentative, based on a biased sampling of places and a lack of rigorous testing of any intuitive beliefs mentioned herein. Over-interpretation of fluctuations and of consistent linear trends, is the most readily apparent flaw in such a visual description where two people can draw entirely different conclusions.

In summary, however, the ratio of population to labour units is increasing through time and therefore centrality is decreasing. This change is most readily apparent in the "larger" small urban places

(greater than 1000), particularly in the later years of observation. Observable changes in centrality at each time period might be associated with changes that have taken place in the region as a whole, or each settlement individually.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The need for a temporal dimension in central place theory is clearly outlined in this study, and by extrapolating one small aspect of central place theory -- the notion of centrality -- it was possible to outline some of the findings and problems of a temporal analysis.

Centrality, in this study, refers strictly to the influence or dominance of an urban place over its umland. Set in a comparative framework, urban centres of varying sizes are analyzed relative to each other, comparing their indices of centrality at various points in time.

Measures of centrality are reviewed with particular attention paid to the ratios of population to establishments, to functions and to functional units. Various "weighting measures" have been used to expand the comparability of these measures of central activity-content in an urban place. One of these measures is the weighting of each central activity by the number of employees. The term "labour unit" or central labour unit is therefore derived to approximate a weighted functional unit. Occupational structure, in terms of the simple raw data provided in the historical directories, is used to gain a measure of a centre's influence over a surrounding region. In other words, a centre A with 500 people and 25 labour units has less centrality, or less influence over a surrounding region, than centre B with 500 people and 50 labour units. The derivation of this "labour unit index", as a logical outcome

of the studies on centrality and as a means of utilizing the data

provided in the historical directories, stands as the first contri-

bution of this research.

Furthermore, the historical directories, which begin about 1850

for all of "Canada" (what is now Ontario and Quebec), and stop about

1910 for the province of Ontario, are revealed as an excellent source

of data for this study and for future work in urban geography. Their

continuity during this period was often sporadic and results frequently

were of questionable accuracy. Nevertheless, the form of the data

fitted well with the aforementioned labour unit index.

In attempting such a temporal analysis of changing centrality,

many problems are revealed. Foremost among these is the inconclusive

denoting of a central activity. No refinements have been made on

Christaller's original definition and the need for an exacting defini-

tion of a central activity or in this case, central profession, becomes

even more apparent in a study over time. Two criteria, final market

in the immediate area and year-round operation, are used in this study

to operationally define central activity, but these too show obvious

deficiencies. The problems of a temporal analysis of central places

are many, but the need for an exacting definition of central activity

is imperative before further work will have significant comparative

value. Underlining this weakness is the second major contribution of

this research.

The third major contribution is the analysis of the population-

labour units relationship. Population, the independent variable, and

labour units, the dependent variable, are graphed and a least-squares

regression line fitted to the distribution. This is carried out for each of the eleven time periods from 1857 to 1907. A comparison of these regression lines for each time period reveals a marked decline through time with the change being most significant between a clustering from c.1882 to c.1903 and the 1907 regression line. Two inter-related explanations are offered for these changes: one associated with a change in labour units while population remains constant, and the other with change in population while labour units remain constant. 'Average' changes in given size centres can be extrapolated directly from the changing slope of the regression lines. However, information on many of the places is not continuous through time, and therefore, a selected sample of the most complete (in terms of temporal coverage) places is made. In this instance of individual places, the ratio of population to labour units (the dependent variable) is plotted against time (the independent variable). The best-fit regression line substantiates the overall decline in centrality. Further, there seems to be a fairly regular change in centrality in different size places. Some major fluctuations from year to year tend to inhibit stronger conclusions from being drawn, and these fluctuations are greatest in the smallest size centres. Although the opportunities for analysis have not been exhausted, it is clearly substantiated that a decline in centrality in small urban centres occurs through time.

Prospects for further research stemming from this work are numerous.

First, the necessity of a redefinition of a central activity (central goods and services, central profession) is necessary. A return

to Christaller's initial statement is required because empirical studies, as described in chapters 2 and 4, are lacking in any clear-cut concept of a central activity. Berry, in his masters thesis,[1] points out the criticism levelled by Harris and Ullman regarding the appropriateness of Christaller's activities. In light of the points raised in chapter 4, it now appears that their criticism may have been out of context due to the changing nature of central goods and services evidenced to be occurring over time.

Second, the mapping of what is now basically an 'aspatial concept', is necessary. No consideration of distance to similar sized centres or dominance by a larger centres is made. Marshall[2] has managed to study central place 'systems' at two distant points in time, but only to the limited extent of visual analysis.

Third, with the increasing use of new statistical techniques borrowed from allied disciplines, some other means of analysis should be considered for occurrences in time and space where dependence of observations is inevitable.

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[1] B. J. L. Berry, "Geographic Aspects of the Size and Arrangement of Urban Centers," unpublished M.A. thesis, University of Washington, 1956 with reference to E. L. Ullman, "A Theory of Location for Cities," American Journal of Sociology, 46 (1941), pp. 835-864 and C. D. Harris and E. L. Ullman, "The Nature of Cities," Annals of the American Academy of Political and Social Science, 242 (1945), pp. 7-17.

[2] J. U. Marshall (1964), op. cit.

## APPENDIX I

The following list of places include all those mentioned in the directories (see chapter 3) from 1846 to 1907. Some place names have been changed during this time (1846-1907), and so that the correlation and regression analysis would not count data under more than one name for any place, the data was put in appendix II under its last-known place name. Those places not found in appendix II, but present in appendix I, were therefore either incomplete or had undergone a change of name.

The source for the change in place names is given by the date in brackets. Those from 1846 to 1907 refer to the directories, while several historical works were used to complement them. These included:

      a) Elford, Jean Turnbull, A History of Lambton County, 1967.

      b) Johnston, A. J., Lambton County Place Names, 1925.

      c) Lauriston, Victor, Lambton County's Hundred Years 1849-1949, 1949.

Date of first survey or the laying out of the first town-site, date of first settlement, date of establishment of the first post office, and date of incorporation as a village, town or city are included where available. Their inclusion was merely to check the validity of some of the data given in appendix II.

For example,

| | | |
|---|---|---|
| (1864) | – | directory or book reference |
| 1849su | – | date laid out or surveyed |
| 1856se | – | date settled |
| 1863p | – | date of first post office |
| 1888Iv | – | date incorporated as village |
| 1896It | – | date incorporated as town |
| 1906Ic | – | date incorporated as city |

Aberarder - 1833se, 1863p
Aberfeldy
Alvinston - formerly Gardiner's Mills (1925), then Brooke's Mills
        (1967) - 1839se, 1854p, 1880Iv
Appledore
Arkona - Eastman's Corners until 1850 (1925), then post office called
        Bosanquet (1866) and town known as Smithfield (1967) - 1832se,
        1851p, 1876Iv
Arkwood - station for Louisville (1888, 1892, 1903)
Atkin - 1897p
Aughrim - 1855p
Avonry
Baby's Point - discontinued as post office (1892) - 1826se, 1852p
Baldoon
Bear Line
Beaver Meadow - 1900p
Becher - 1865p
Benpath
Bentley
Bickford - station called Watson (1892, 1903)
Big Point
Birkhall - post office called Brigden (1892) - 1860p
Birnan
Blackwell Station
Blenheim - formerly Rondeau (1864, 1888, 1892) - 1848su, 1845se, 1874Iv,
        1884It
Botany - 1831se, 1865p
Bothwell - 1855su, 1858se, 1867It
Bradshaw
Bridgend
Brigden - 1876se
Bright Grove
Buckhorn - name changed to Cedar Springs (1888, 1892) - 1850p
Bunyan
Buxton - 1852se, 1850Iv
Cairo - formerly Sutherland's Corners (1925)
Camlachie - station in 1863
Cedar Springs - used to be called Buckhorn (1892)
Charing-Cross - 1828se, 1861p
Charlemont
Chatham - 1832su, 1855 area increased by annexation, 1827se, 1851It,
        1895Ic
Chatham Centre - name changed to Eberts which was formerly its post
        office (1888, 1892)
Clachan
Clearville - 1832p
Coatsworth Station
Cole's Corners - see Lucasville (1892)
Colinville - 1851p
Copleston - once called Marthaville (1888, 1892) - 1859se, 1865p

Corunna - 1835su, 1851p
Courtright - 1872su, 1874p, 1907Iv
Cromar
Croton - once called Johnston's Corners (1857)
Cuthbert - 1892p
Dante
Carrell
Dawn Centre - name changed to Rutherford (1888, 1892)
Dawn Mills - 1863su
Dawn Valley - 1890p
Dealtown - 1859p
Dolsen
Dover Centre
Dover South - 1853se
Doyles - recently established post office (1888)
Dresden - 1846su, 1854p, 1881It
Duart - 1857p
Dubuque
Duthiel
Eberts - once Chatham Centre (1888, 1892)
Edgeworth - see Valetta (1866)
Edy's Mills
Ennett - station for Turnerville (1892, 1898)
Erieau
Errol - 1833su
Fairfield - once called Troy (1866, 1869); name later changed to
        Ridley (1888, 1892)
Fargo
Fletcher
Florence - once called Zone Mills (1946) and Victoria (1871) 1836su,
        1840p
Forest - 1859se, 1861p, 1872Iv, 1888It
Froomfield - also called Talfourd's (1946) - Corunna was post office
        (1866) - 1836su
Glen Rae - 1888se
Glenwood Station
Golden Creek - post office for Oban (1857, 1869), name changed to
        Port Franks
Grand Bend - Brester once name of Lambton part (1925) - 1832se
Grove Mills - discontinued post office (1892)
Guilds
Harwich(ville) - once called McKay's Corners (1871) - 1847su
Harwich Station - name changed to Mull, its post office (1888)
Harwich Centre - name changed to Huffman (1888)
Haycroft - only station (1903)
Heather - discontinued post office (1903)
Henderson - also called Tilbury Centre
Henry's Corners
Highgate - 1865p
Hillsboro' - discontinued post office (1903) - 1834se, 1856p
Holmesdale - only flag station (1903)
Hossie Corners - name changed to Logierait (1892)

Huffman - formerly Harwich Centre, now discontinued post office
      (1888, 1892)
Inwood
Irwin - discontinued post office (1892)
Jeannette's Creek - formerly Baptiste Creek (1888)
Jericho
Jura
Kent Bridge - 1863p
Kent Centre
Kertch - once called East Plympton (1857)
Kimball - post office is at Wilkesport (1866) - 1852p
Kingscourt
Kinnaird - discontinued post office (1888, 1892)
Ladysmith
Lambton - post office at Baby's Point
Langbank
Larwill - discontinued post office (1892)
Lewisville - name changed to Northwood, its post office (1888)
Lidcote - discontinued post office (1892)
Logierait - formerly Hossie Corners (1892)
Louisville - 1830p
Lowlands - discontinued post office
Lucasville - formerly Lucas and Cole's Corners (1892)
Lundy - discontinued post office (1892)
Lynwood
McCready
Mandaumin - once called Radcliffe (1925) - 1856su, 1862p
Marthaville - name changed to Copleston (1888, 1892)
Matlock
Merlin - sometimes called Smith's Corners (1871)
Mitchell's Bay
Mooretown - originally called Moore (1949) - 1852su
Moraviantown
Morpeth - once called Jamesville (1846) - 1830p
Mosside
Muir Kirk
Mull - post office for Harwich Station (1888, 1892)
North Buxton
Northwood - name changed to Lewisville (1888, 1892)
Oakdale
Oban - post office called Plympton (1857)
Ogemah - discontinued post office (1903)
Oil City
Oil Springs - once called Black Creek (1925) - 1860su, 1859p, 1865lv
Oldfield - discontinued post office (1903)
Old Montrose - 1831se, 1864p
Osborne
Ossian
Ostrander - name changed to Selton (1871)
Oungah
Ouvry
Palmyra

Perch Station
Petrolea - 1838se, 1861p, 1866Iv, 1873It
Petrolea Junction
Pine Hurst
Point Edward - once called Huron Village (1866, 1871) - 1865p, 1838se,
        1879Iv
Port Alma
Port Franks - post office once called Golden Creek (1857, 1864)
Port Lambton - 1820se
Prairie Siding - name changed to Williams (1888, 1892)
Quinn
Raleigh - only station (1903)
Ramsgate - post office called Ridgetown to which included (1888, 1892)
Ravenswood - 1855p
Renwick
Richardson - only station (1892)
Ridgetown - 1844se, 1882It
Ridley - formerly Trow and Fairfield (1888, 1892)
Ringold - only station (1892)
Rokeby - recently established post office (1892)
Romney
Rondeau - now called Blenheim (1888)
Rondeau Harbour - or Rond'eau, Point aux Pins or Landguard (1846)
Rutherford - once called Dawn Centre (1888, 1892)
Sandison Station - only station (1903)
Sarnia - 1833su, 1857Iv
Seckerton
Selton - once called Ostrander (1871)
Shetland - once called Dobbyn's Mills (1925)
Shrewsbury - post office called Rondeau (1892)
Sombra - 1851p
Stevenson
Stewart - once called Tilbury East (1888, 1892)
Summersmill - post office at Brewster (1871)
Sutherland's Corners - later called Cairo (1925) - 1833su
Sutorville
Sykeston
Tancred
Terminus
Thamesville - once called Tecumseh (1866, 1871) - 1856su, 1874Iv
Thedford - once called Widder Station (1866 - 1859se, 1862p, 1877Iv
Thorncliffe
Thornyhurst
Tilbury - once called Tilbury Centre (1898, 1903, 1907)
Tilbury Centre - once called Henderson (1888)
Tilbury East - name changed to Stewart (1888, 1892) - 1851p
Troy - name changed to Ridley; once called Fairfield (1871) and earlier
        Troy Mills (1857) - 1863p
Tupperville
Turin - discontinued post office (1903)
Turnerville - station called Ennett (1898)

Uttoxeter
Valetta - 1833se, 1864p
Van Horn - post office for Vosburg station (1903)
Vosburg - only station, post office called Van Horn (1903)
Vyner
Wabash
Wallaceburg - 1835p
Walnut
Wanstead - 1859p
Warwick - 1830se, 1835p
Watford - once called Brown's Corners (1925) - 1853se, 1854p, 1875Iv
Watson Station - post office at Bickford (1903)
Waubuno
Wawanosh - only station (1903)
Weidmann
Weldon
Wheeler
Whitebread Station
Widder - post once called Pine Hill (1857) - discontinued (1892)
Widder Station - name changed to Thedford (1866, 1869)
Wilkesport - post office for Kimball (1866)
Wilkie - only station (1903)
Williams - formerly Prairie Siding (1888, 1892)
Wilsoncroft
Wisbeach
Wyoming - originally called the Anderson Settlement (1967), 1858p,
        1874Iv

APPENDIX II

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aberarder* | | | | | 50 | 50 | 100 | 100 | 100 | 60 | | 100 | |
| | | | | | 12 | 14 | 15 | 13 | 4 | 10 | | 1 | |
| Aberfeldy | | | | | | | | | 55 | 60 | 70 | 100 | 100 |
| | | | | | | | | | 9 | 11 | 2 | 3 | 13 |
| Alvinston | | | 50 | 100 | | | | 1000 | 1200 | 1200 | 1200 | 800 | 1000 |
| | | | 5 | 11 | | | | 72 | 61 | 84 | 74 | 81 | 82 |
| Appledore | | | | | | | | | 100 | 100 | | | |
| | | | | | | | | | 6 | 6 | | | |
| Arkona | | | 400 | | 550 | 500 | 500 | 800 | 800 | 800 | 475 | 500 | 600 |
| | | | 47 | | 62 | 49 | 59 | 32 | 51 | 67 | 41 | 45 | 47 |
| Aughrim | | | 25 | | | 75 | 50 | 75 | 75 | 75 | 50 | 100 | |
| | | | 1 | | | 10 | 4 | 12 | 7 | 8 | 2 | 3 | |
| Avonry | | | | | | | | | 75 | | 50 | 50 | |
| | | | | | | | | | 2 | | 2 | 2 | |
| Baby's Point | | | 100 | 50 | 150 | 100 | 50 | 50 | 50 | | | | |
| | | | 5 | 4 | 8 | 12 | 7 | 4 | 8 | | | | |
| Baldoon | | | | | | | | | 50 | 50 | 100 | 150 | |
| | | | | | | | | | 7 | 9 | 3 | 2 | |
| Bear Line | | | | | | | | | | | | 50 | |
| | | | | | | | | | | | | 1 | |
| Becher | | | | | | | | | 30 | 30 | 50 | 50 | |
| | | | | | | | | | 2 | 3 | 1 | 1 | |
| Benpath | | | | | | | | | 40 | 20 | 25 | 100 | |
| | | | | | | | | | 2 | 2 | 1 | 1 | |
| Bickford | | | | | | | | | | 200 | 100 | 200 | 200 |
| | | | | | | | | | | 2 | 2 | 2 | 1 |
| Big Point | | | | | | | | | 100 | 100 | 100 | 50 | 50 |
| | | | | | | | | | 4 | 5 | 1 | 3 | 3 |
| Birkhall | | | | | | 50 | | | | | | | |
| | | | | | | 13 | | | | | | | |

* Note that for each place at each time period, the first number refers to the population while the second number refers to the number of labour units.

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Birnam | | | | | | | | | 150 | 150 | 100 | 100 | 50 |
| | | | | | | | | | 6 | 9 | 3 | 2 | 6 |
| Blackwell Stn. | | | | | | | | | | 50 | | | |
| | | | | | | | | | | 7 | | | |
| Blenheim | | | 450 | 500 | 550 | 750 | 850 | 1500 | 2200 | 1800 | 1800 | 1800 | 1800 |
| | | | 25 | 54 | 77 | 51 | 86 | 84 | 96 | 35 | 111 | 95 | 96 |
| Botany | | | | | | | | 100 | 100 | 100 | | | |
| | | | | | | | | 9 | 7 | 6 | | | |
| Bothwell | | | 500 | 300 | 3700 | 1600 | 1500 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| | | | 24 | 16 | 406 | 70 | 160 | 90 | 79 | 77 | 96 | 84 | 68 |
| Bradshaw | | | | | | | | | 100 | 100 | 75 | 75 | 75 |
| | | | | | | | | | 9 | 10 | 8 | 5 | 3 |
| Brigden | | | | | | | | 450 | 650 | 750 | 800 | 800 | 800 |
| | | | | | | | | 54 | 45 | 45 | 44 | 52 | 52 |
| Bunyan | | | | | | | | | 30 | 30 | | | |
| | | | | | | | | | 1 | 2 | | | |
| Buxton | | | 500 | | 100 | 100 | 100 | 50 | 100 | 200 | 50 | 100 | 100 |
| | | | 11 | | 17 | 9 | 9 | 10 | 13 | 8 | 6 | 3 | 3 |
| Cairo | | | | | | | 80 | 80 | | 150 | 50 | 50 | 50 |
| | | | | | | | 5 | 21 | | 19 | 5 | 6 | 5 |
| Camlachie | | | | | 100 | | 50 | 125 | 200 | 250 | 250 | 250 | 250 |
| | | | | | 2 | | 11 | 24 | 16 | 24 | 11 | 10 | 11 |
| Cedar Springs | | | | | | 50 | 75 | | 200 | 300 | 200 | 200 | |
| | | | | | | 8 | 8 | | 33 | 29 | 14 | 12 | |
| Charing Cross | | | | 50 | | 100 | 150 | 150 | 200 | 200 | 160 | 150 | 150 |
| | | | | 6 | | 8 | 10 | 16 | 8 | 3 | 5 | 4 | 3 |
| Charlemont | | | | | | | | | | | | 50 | 50 |
| | | | | | | | | | | | | 1 | 2 |
| Chatham | | 2200 | 6000 | 4466 | | 5000 | 6000 | 8000 | 9000 | 9500 | 10000 | 9222 | 14000 |
| | | 82 | 256 | 245 | | 397 | 714 | 526 | 451 | 478 | 589 | 486 | 481 |
| Clachan | | | | | | | | 50 | 100 | 100 | 100 | 100 | |
| | | | | | | | | 2 | 6 | 4 | 4 | 3 | |
| Clearville | | | 100 | 100 | 100 | 105 | 150 | 150 | 100 | 100 | 100 | 35 | |
| | | | 14 | 13 | 14 | 18 | 14 | 16 | 20 | 23 | 3 | 3 | |
| Coatsworth Stn. | | | | | | | | | | | 160 | 150 | 150 |
| | | | | | | | | | | | 15 | 8 | 3 |
| Colinville | | | | 50 | | 60 | 100 | 100 | 200 | 200 | 300 | 300 | |
| | | | | 10 | | 7 | 8 | 15 | 5 | 11 | 2 | 3 | |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copleston | | | | | | | | 100 | 300 | 300 | 200 | 200 | 200 |
| | | | | | | | | 13 | 14 | 12 | 8 | 3 | 2 |
| Corunna | | 150 | 200 | 210 | 200 | 200 | 200 | 200 | 300 | 250 | 200 | 250 | 250 |
| | | 22 | 11 | 34 | 53 | 40 | 31 | 11 | 12 | 23 | 14 | 6 | 12 |
| Courtright | | | | | | | | 500 | 500 | 500 | 600 | 600 | 600 |
| | | | | | | | | 22 | 36 | 49 | 36 | 21 | 27 |
| Croton | | | | 70 | 75 | 80 | | | 200 | 200 | 40 | 50 | 50 |
| | | | | 7 | 1 | 5 | | | 15 | 20 | 5 | 2 | 2 |
| Dante | | | | | | | | | 50 | | 50 | | |
| | | | | | | | | | 2 | | 2 | | |
| Darrell | | | | | | | | | 200 | 200 | 100 | 50 | 50 |
| | | | | | | | | | 4 | 3 | 2 | 1 | 2 |
| Dawn Mills | | | | 100 | 200 | 100 | 75 | 75 | 100 | 100 | 100 | 100 | 100 |
| | | | | 17 | 31 | 12 | 18 | 10 | 4 | 5 | 3 | 1 | 2 |
| Dealtown | | | | | | | 150 | 150 | | 50 | 150 | | |
| | | | | | | | 12 | 4 | | 2 | 2 | | |
| Dolsen | | | | | | | | | 50 | 120 | | | |
| | | | | | | | | | 6 | 18 | | | |
| Dover Centre | | | | | | | | | | | 25 | 100 | |
| | | | | | | | | | | | 3 | 2 | |
| Dover South | | | | 75 | | | 100 | 100 | 200 | 200 | 100 | 100 | 100 |
| | | | | 8 | | | 10 | 22 | 22 | 8 | 7 | 4 | 5 |
| Dresden | | | 300 | 350 | 600 | 650 | 1000 | 2100 | 2500 | 2500 | 2500 | 2500 | 2500 |
| | | | 23 | 48 | 55 | 67 | 78 | 94 | 126 | 140 | 142 | 112 | 101 |
| Duart | | | | 300 | 250 | 350 | 200 | 200 | 250 | 200 | 300 | 300 | 300 |
| | | | | 22 | 34 | 33 | 24 | 32 | 22 | 23 | 2 | 16 | 11 |
| Eberts | | | | | | | | | 50 | 50 | 50 | 50 | |
| | | | | | | | | | 2 | 2 | 2 | 1 | |
| Edgeworth | | | | | | | 50 | | 200 | | | | |
| | | | | | | | 6 | | 23 | | | | |
| Errol | | | 50 | 70 | 100 | 50 | 100 | | | | | | |
| | | | 6 | 7 | 4 | 3 | 5 | | | | | | |
| Fargo | | | | | | | | | 100 | 75 | 100 | 100 | 75 |
| | | | | | | | | | 11 | 8 | 2 | 3 | 2 |
| Fletcher | | | | | | | | 200 | 250 | 250 | 200 | 200 | 200 |
| | | | | | | | | 10 | 14 | 7 | 7 | 7 | 9 |
| Florence | 100 | | 300 | 300 | 300 | 350 | 350 | 450 | 500 | 500 | 500 | 500 | 500 |
| | 5 | | 40 | 36 | 38 | 46 | 52 | 52 | 49 | 46 | 33 | 36 | 29 |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest | | | | | 250 | 259 | 500 | 1600 | 2200 | 2057 | 2057 | 1700 | 2000 |
|  | | | | | 45 | 45 | 59 | 123 | 124 | 134 | 122 | 117 | 128 |
| Froomfield | 40 | | 150 | | | | | | | | | | |
|  | 7 | | 8 | | | | | | | | | | |
| Glen Rae | | | | | | | | | 150 | 150 | 100 | 100 | |
|  | | | | | | | | | 2 | 4 | 3 | 3 | |
| Glenwood Stn. | | | | | | | | | | | | 50 | |
|  | | | | | | | | | | | | 2 | |
| Grand Bend | | | | | | | | | 150 | 150 | 50 | 50 | 50 |
|  | | | | | | | | | 6 | 3 | 4 | 8 | 14 |
| Guilds | | | | | | | | | 100 | 100 | 100 | 100 | |
|  | | | | | | | | | 4 | 3 | 3 | 3 | |
| Harwich | | | | 100 | 100 | | 100 | 50 | 100 | 100 | 100 | 100 | 100 |
|  | | | | 3 | 1 | | 15 | 12 | 19 | 23 | 9 | 7 | 3 |
| Highgate | | | | | 75 | 100 | 70 | 250 | 400 | 400 | 400 | 400 | 400 |
|  | | | | | 18 | 12 | 10 | 36 | 46 | 46 | 30 | 37 | 36 |
| Hillsboro' | | | 100 | | 70 | 80 | 50 | | 50 | 50 | | | |
|  | | | 12 | | 16 | 15 | 7 | | 5 | 5 | | | |
| Inwood | | | | | | | | | 450 | 450 | 400 | 400 | 400 |
|  | | | | | | | | | 17 | 20 | 12 | 31 | 30 |
| Jeannette's Creek | | | | | | | | | | | | 50 | 50 |
|  | | | | | | | | | | | | 1 | 2 |
| Jericho | | | | | | | | | 20 | 20 | 40 | | |
|  | | | | | | | | | 2 | 4 | 3 | | |
| Jura | | | | | | | 50 | 50 | 100 | 100 | | | |
|  | | | | | | | 3 | 5 | 3 | 2 | | | |
| Kent Bridge | | | | | 120 | 45 | 50 | 50 | 150 | 150 | 150 | 50 | 50 |
|  | | | | | 11 | 7 | 7 | 16 | 8 | 26 | 5 | 9 | 11 |
| Kertch | | | 150 | | | 75 | | 75 | 70 | 70 | 75 | 75 | |
|  | | | 8 | | | 7 | | 9 | 5 | 1 | 3 | 3 | |
| Kimball | | | | | 150 | | | | 50 | 50 | 25 | 25 | |
|  | | | | | 18 | | | | 1 | 1 | 1 | 1 | |
| Kingscourt | | | | | | | | | 50 | 50 | 50 | 50 | |
|  | | | | | | | | | 3 | 5 | 4 | 4 | |
| Lidcote | | | | | | | | | 75 | | | | |
|  | | | | | | | | | 7 | | | | |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Logierait | | | | | | | 50 | 100 | 100 | 100 | 100 | | |
| | | | | | | | 12 | 7 | 6 | 7 | 2 | | |
| Louisville | 70 | | 200 | | | 85 | 100 | 100 | 100 | 65 | 100 | 100 | |
| | 11 | | 10 | | | 16 | 12 | 14 | 12 | 11 | 4 | 2( | |
| Lucasville | | | | | | | 75 | 75 | 100 | 100 | 150 | | |
| | | | | | | | 9 | 8 | 3 | 3 | 2 | | |
| Lundy | | | | | | | | | 30 | | | | |
| | | | | | | | | | 2 | | | | |
| Mandaumin | | | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | | 13 | 9 | 11 | 9 | 3 | 2 | 3 |
| Merlin | | | | | | | 75 | 125 | 200 | 200 | 300 | 100 | 800 |
| | | | | | | | 13 | 22 | 16 | 17 | 22 | 39 | 53 |
| Mitchell's Bay | | | | | | | | | 200 | 200 | 200 | 100 | 100 |
| | | | | | | | | | 8 | 9 | 3 | 3 | 2 |
| Mooretown | | 100 | 200 | 250 | 350 | 450 | 400 | 400 | 250 | 250 | 250 | 250 | 200 |
| | | 11 | 46 | 64 | 26 | 27 | 42 | 34 | 24 | 21 | 12 | 11 | 14 |
| Morpeth | | | 550 | 500 | 600 | 600 | 600 | 700 | 550 | 550 | 600 | 600 | 300 |
| | | | 37 | 69 | 65 | 46 | 80 | 37 | 34 | 28 | 16 | 13 | 10 |
| Mosside | | | | | | | | | 75 | 75 | 100 | 100 | |
| | | | | | | | | | 3 | 8 | 2 | 2 | |
| MuirKirk | | | | | | | | 500 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | | | 8 | 11 | 11 | 5 | 6 | 6 |
| Mull | | | | | | | | | 70 | 125 | 125 | 125 | 125 |
| | | | | | | | | | 9 | 8 | 2 | 4 | 3 |
| North Buxton | | | | | | | | 100 | 300 | 175 | 150 | 150 | 150 |
| | | | | | | | | 6 | 12 | 14 | 4 | 2 | 4 |
| Northwood | | | | | | | | | 100 | 100 | 100 | 100 | 100 |
| | | | | | | | | | 8 | 6 | 5 | 3 | 2 |
| Oakdale | | | | | | | | | 40 | 21 | | 50 | 50 |
| | | | | | | | | | 3 | 3 | | 2 | 5 |
| Oban | | | 50 | | | | 175 | | | | | | |
| | | | 9 | | | | 8 | | | | | | |
| Oil City | | | | | | | | 400 | 700 | 500 | 500 | 500 | 500 |
| | | | | | | | | 22 | 40 | 42 | 12 | 6 | 3 |
| Oil Springs | | | | 2000 | 3000 | 750 | 850 | 500 | 1062 | 1100 | 1100 | 1000 | 1000 |
| | | | | 132 | 247 | 60 | 55 | 26 | 93 | 100 | 89 | 93 | 76 |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ogemah | | | | | | | | | | 50 | | | |
| | | | | | | | | | | 1 | | | |
| Oldfield | | | | | | | | | | 50 | 50 | | |
| | | | | | | | | | | 5 | 4 | | |
| Osborne | | | | | | | | | 75 | 75 | 150 | | |
| | | | | | | | | | 6 | 9 | 4 | | |
| Ossian | | | | | | | | | | 50 | | | |
| | | | | | | | | | | 1 | | | |
| Oungah | | | | | | | | | 150 | 150 | | 50 | |
| | | | | | | | | | 10 | 5 | | 1 | |
| Ouvry | | | | | | | | | | 50 | 75 | 75 | |
| | | | | | | | | | | 12 | 3 | 2 | |
| Palmyra | | | | | | | | | 50 | 75 | 100 | 100 | 100 |
| | | | | | | | | | 4 | 9 | 4 | 6 | 4 |
| Perch Station | | | | | | | 20 | | | | | | |
| | | | | | | | 2 | | | | | | |
| Petrolea | | | | 300 | 2300 | 1000 | 3000 | 3000 | 5500 | 4357 | 4591 | 4591 | 4700 |
| | | | | 14 | 243 | 87 | 415 | 154 | 223 | 234 | 245 | 197 | 191 |
| Pine Hurst | | | | | | | | | | | 50 | | |
| | | | | | | | | | | | 3 | | |
| Point Edward | | | | | 600 | | 1000 | 1000 | 2500 | 1882 | 1900 | 1000 | 1000 |
| | | | | | 120 | | 58 | 37 | 36 | 38 | 18 | 25 | 23 |
| Port Alma | | | | | | | | | 150 | 150 | 150 | 50 | |
| | | | | | | | | | 6 | 3 | 5 | 5 | |
| Port Franks | | | 50 | 75 | 75 | 200 | 70 | 70 | 100 | 100 | 100 | 100 | |
| | | | 7 | 12 | 1 | 6 | 14 | 4 | 10 | 2 | 2 | 3 | |
| Port Lambton | | | | | | | | | 500 | 500 | 500 | 300 | 300 |
| | | | | | | | | | 20 | 28 | 12 | 11 | 10 |
| Quinn | | | | | | | | | 150 | 150 | 150 | 150 | |
| | | | | | | | | | 9 | 8 | 3 | 1 | |
| Ravenswood | | | | 40 | 50 | 65 | 50 | 50 | 80 | 80 | 100 | 100 | 100 |
| | | | | 2 | 7 | 14 | 9 | 7 | 8 | 9 | 3 | 2 | 3 |
| Renwick | | | | | | | | | | | 400 | 50 | |
| | | | | | | | | | | | 2 | 1 | |
| Ridgetown | | | 80 | 355 | 350 | | .500 | 500 | 3500 | 2254 | 2254 | 2500 | 2500 |
| | | | 44 | 42 | 58 | | 58 | 128 | 132 | 167 | 152 | 121 | 118 |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ridley |  |  |  |  | 100 |  | 150 | 150 | 100 | 100 | 100 | 25 |  |
|  |  |  |  |  | 12 |  | 15 | 4 | 5 | 6 | 4 | 2 |  |
| Rokeby |  |  |  |  |  |  |  |  |  | 50 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 2 |  |  |  |
| Romney |  |  | 400 |  |  |  |  | 20 | 175 | 175 | 50 |  |  |
|  |  |  | 4 |  |  |  | – | 9 | 12 | 10 | 4 |  |  |
| Rondeau (harbour) |  |  |  |  | 200 | 360 | 150 | 150 | 250 | 50 | 200 | 200 |  |
|  |  |  |  |  | 14 | 5 | 9 | 5 | 7 | 11 | 4 | 1 |  |
| Rutherford |  |  |  |  |  |  | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
|  |  |  |  |  |  |  | 2 | 8 | 8 | 5 | 8 | 3 | 4 |
| Sarnia | 420 |  | 1200 | 2100 |  | 3000 | 3500 | 3874 | 6000 | 7000 | 7000 | 8000 | 10000 |
|  | 39 |  | 121 | 166 |  | 158 | 398 | 239 | 259 | 310 | 344 | 375 | 318 |
| Seckerton |  |  |  |  |  |  |  |  |  | 200 | 200 | 25 |  |
|  |  |  |  |  |  |  |  |  |  | 4 | 2 | 2 |  |
| Selton |  |  |  |  |  | 50 | 50 | 50 | 75 | 75 | 100 |  |  |
|  |  |  |  |  |  | 12 | 13 | 2 | 3 | 2 | 2 |  |  |
| Shetland |  |  |  |  |  |  | 175 | 175 | 150 | 150 | 150 | 50 | 50 |
|  |  |  |  |  |  |  | 7 | 5 | 10 | 9 | 8 | 7 | ·7 |
| Sombra |  |  | 100 | 500 | 100 | 200 | 100 | 600 | 200 | 200 | 250 | 450 | 850 |
|  |  |  | 16 | 25 | 18 | 19 | 20 | 25 | 21 | 18 | 20 | 23 | 39 |
| Stevenson |  |  |  |  |  |  |  |  |  |  |  | 25 |  |
|  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |
| Stewart |  |  |  |  |  |  |  | 150 | 50 | 100 | 100 | 100 |  |
|  |  |  |  |  |  |  |  | 27 | 4 | 5 | 3 | 3 |  |
| Summersmill |  |  |  |  |  |  | 30 |  |  |  |  |  |  |
|  |  |  |  |  |  |  | 2 |  |  |  |  |  |  |
| Sykeston |  |  |  |  |  |  |  |  |  | 30 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 2 |  |  |  |
| Tancred |  |  |  |  |  |  |  |  |  | 50 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 2 |  |  |  |
| Thamesville | 50 |  | 300 | 400 | 600 | 700 | 500 | 1000 | 1000 | 1000 | 1000 | 900 | 900 |
|  | 4 |  | 21 | 45 | 78 | 43 | 49 | 88 | 55 | 69 | 76 | 75 | 72 |
| Thedford |  |  |  | 300 | 250 | 350 | 500 | 900 | 860 | 800 | 800 | 800 | 625 |
|  |  |  |  | 13 | 31 | 61 | 65 | 51 | 54 | 56 | 41 | 60 | 60 |
| Thorncliffe |  |  |  |  |  |  |  |  | 40 | 40 | 50 | 50 |  |
|  |  |  |  |  |  |  |  |  | 12 | 1 | 1 | 1 |  |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thornyhurst |  |  |  |  |  |  |  |  | 50 | 150 | 200 |  |  |
|  |  |  |  |  |  |  |  |  | 3 | 18 | 1 |  |  |
| Tilbury |  |  |  |  |  |  |  |  | 1200 | 1000 | 1000 | : | 1500 |
|  |  |  |  |  |  |  |  |  | 74 | 75 | 76 |  | 83 |
| Tupperville |  |  |  |  |  |  |  |  | 300 | 300 | 300 | 300 |  |
|  |  |  |  |  |  |  |  |  | 16 | 29 | 7 | 6 |  |
| Turin |  |  |  |  |  |  |  |  |  | 30 | 50 |  |  |
|  |  |  |  |  |  |  |  |  |  | 6 | 1 |  |  |
| Turnerville |  |  |  |  |  |  |  |  |  | 30 | 40 | 40 |  |
|  |  |  |  |  |  |  |  |  |  | 2 | 2 | 1 |  |
| Uttoxeter |  |  |  |  |  |  | 100 | 100 | 100 | 100 | 100 | 100 |  |
|  |  |  |  |  |  |  | 5 | 3 | 10 | 18 | 4 | 4 |  |
| Valetta |  |  |  |  |  |  | 75 | 100 | 200 | 200 | 200 | 100 | 50 |
|  |  |  |  |  |  |  | 9 | 9 | 5 | 6 | 2 | 9 | 2 |
| Van Horn |  |  |  |  |  |  |  |  | 40 | 40 |  | 50 |  |
|  |  |  |  |  |  |  |  |  | 2 | 3 |  | 2 |  |
| Vyner |  |  |  |  |  |  |  |  | 100 | 100 | 100 |  |  |
|  |  |  |  |  |  |  |  |  | 4 | 6 | 2 |  |  |
| Wabash |  |  |  |  |  |  |  |  | 40 | 40 | 50 | 50 |  |
|  |  |  |  |  |  |  |  |  | 2 | 2 | 1 | 2 |  |
| Wallaceburg | 60 | 600 | 500 | 500 | 600 | 600 | 600 | 600 | 3000 | 2726 | 3000 | 3400 | 3500 |
|  | 3 | 30 | 33 | 48 | 102 | 64 | 52 | 107 | 158 | 173 | 162 | 160 | 127 |
| Walnut |  |  |  |  |  |  |  |  | 150 | 50 | 75 | 75 |  |
|  |  |  |  |  |  |  |  |  | 3 | 3 | 2 | 2 |  |
| Wanstead |  |  |  | 80 | 80 | 100 | 130 | 130 | 100 |  | 100 | 100 | 100 |
|  |  |  |  | 28 | 12 | 16 | 13 | 5 | 9 |  | 7 | 2 | 5 |
| Warwick |  |  | 300 | 400 | 200 |  | 300 | 250 | 150 | 150 | 150 | 150 | 150 |
|  |  |  | 29 | 39 | 31 |  | 19 | 24 | 20 | 18 | 10 | 9 | 9 |
| Watford |  |  | 50 |  | 250 | 300 | 400 | 1600 | 1600 | 1600 | 1300 | 1300 |  |
|  |  |  | 8 |  | 20 | 7 | 64 | 188 | 92 | 131 | 114 | 92 |  |
| Weidmann |  |  |  |  |  |  |  |  | 375 | 375 | 350 | 350 |  |
|  |  |  |  |  |  |  |  |  | 5 | 8 | 5 | 2 |  |
| Weldon |  |  |  |  |  |  |  |  | 50 |  |  |  |  |
|  |  |  |  |  |  |  |  |  | 2 |  |  |  |  |
| Wheeler |  |  |  |  |  |  |  |  | 50 | 60 | 100 |  |  |
|  |  |  |  |  |  |  |  |  | 2 | 2 | 3 |  |  |

| NAME OF PLACE | 1846 | 1851 | 1857 | 1864 | 1866 | 1869 | 1871 | 1882 | 1888 | 1892 | 1898 | 1903 | 1907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Whitebread Stn. | | | | | | | | | | 50 | | 50 | |
| | | | | | | | | | | 2 | | 2 | |
| Widder | | | 100 | | 200 | 200 | 100 | 100 | 120 | | 50 | 50 | |
| | | | 24 | | 20 | 19 | 12 | 8 | 3 | | 3 | 1 | |
| Wilkesport | | | | | 150 | | 50 | 200 | 300 | 300 | 200 | 200 | 200 |
| | | | | | 18 | | 21 | 22 | 13 | 11 | 9 | 9 | 10 |
| Williams | | | | | | | | | 75 | | | 50 | 50 |
| | | | | | | | | | 1 | | | 3 | 2 |
| Wilson Croft | | | | | | | | | 60 | 60 | | | |
| | | | | | | | | | 2 | 1 | | | |
| Wisbeach | | | | | | | | | | | | 40 | |
| | | | | | | | | | | | | 2 | |
| Wyoming | | | 150 | | 750 | 400 | 500 | 900 | 1100 | 850 | 900 | | |
| | | | 14 | | 102 | 28 | 57 | 63 | 71 | 75 | 68 | | |

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It has been divided into three main parts:

(a) LITERATURE REVIEW.  Articles which review the topic of centrality and its various related notions, both within, and outside of, geography.

(b) DATA COLLECTION.  Those historical directories (listed in order of date, rather than alphabetically) and "local histories" related to the data collection.

(c) STATISTICAL ANALYSIS.  Those statistical texts which were of use in analyzing the data.

The bibliography is by no means a complete compendium of all works on each subject, but includes only those articles mentioned in the text of the thesis.

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