CENTRAL PLACE THEORY IN PERTH AND HURON COUNTIES, ONTARIO: AN ATTEMPT AT AN APPLICATION OF CHRISTALLER'S THEORY

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

Urban geographers have traditionally concerned themselves with the important relationship between the location and function of settlements. Recent studies have sought to develop and confirm the existence and nature of systems of urban centres, systems which can account for size, function and location in terms of empirically sound theory. The aim of urban location theory is the arrangement of complex reality into relatively simple and meaningful patterns.

1. The Aims of This Study

The purpose of this study is threefold:

1) to identify a system of centres in the context of the most comprehensive framework of urban location-size-function relations: central place theory;

2) to indicate the extent to which the service centre pattern in Perth and Huron counties, Ontario reflects the theoretical spatial concepts of central place theory;

3) to indicate the locative factors which contribute to or deviate from the order of central place theory.

The third objective of this thesis is necessary in order to determine whether the areal pattern conforms to

theory because of the assumptions of the theory, or whether alternate concepts are equally acceptable. Many investigators outside the field of urban geography have delimited and described a class system of service centres, but causal analysis of distribution patterns is characteristically the role of the geographer.

The suppositions of this study are that:

1) it is possible to recognize at least four sets of central places in Perth and Huron counties;

2) the spatial distribution of service centres does reflect certain principles of central place theory;

3) historical-geographical locative factors may both contribute to or deviate from the essential spatial order of central place theory.

2. Principles of Central Place Theory

The original formulation of central place theory is attributed to Walter Christaller, a German geographer.[1] He set down a theory designed to explain the size, number and distribution of urban places. Subsequently many valuable additions to the field of central place study have been contributed by other geographers as well as by sociologists,

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[1]Walter Christaller, Die zentralen Orte in Süddeutschland (Jena: Gustav Fischer Verlag, 1933).

All specific references to Christaller's work in this study are taken from the translation by Carlisle W. Baskin, Central Places in Southern Germany (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966).

human ecologists, economists, historians and urban planners.[1]

(a). Summary of the Origin and Development of Urban Centres

Harris and Ullman have summarized the development of urban places into three categories:

1) transport centres which act as collection and distribution points on long-distance media of transportation;

2) specialized-function centres which are founded and develop in response to local land resources--such is the case for mining, manufacturing, pulp and paper and resort towns;

3) central places which owe their existence and growth to a surrounding dispersed rural population which utilizes the essential services these communities provide.[2]

Although many centres are supported by more than one of these urban causation factors, it appears that nearly every community has an almost standard assemblage of activities performed by its inhabitants for an area external to the centre itself. These ubiquitous services are referred to as central service functions, and the centre whose chief role is the provision of these functions is known as a central

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[1]An extensive annotated bibliography has been compiled by Brian J. L. Berry and Allen Pred, Central Place Studies: A Bibliography of Theory and Applications (Bibliography Series, No. 1; Philadelphia: Regional Science Research Institute, 1961; reprinted 1965 with supplement through 1964 by H. G. Barnum, R. Kasperson, and S. Kiuchi).

[2]Chauncy D. Harris and Edward L. Ullman, "The Nature of Cities," Annals of the American Academy of Political and Social Science, CCXLII (November, 1945), pp. 7-17.

place. The latter term is used because to perform its functions most efficiently the service agglomeration should be in a position central to travel distance from all parts of its tributary area. "The chief profession--or characteristic --of a town is to be the center of a region."[1]

(b). Central Service Range and Threshold

The range of a central service function marks out the trade area around a central place from which people travel to purchase the good or service. Other terms used to define this area are complementary region, sphere of influence, umland, urban field and tributary area.

The upper or outer limit of the range is ideally the maximum radius of sales of the good or service from a given central place. The lower limit or threshold determines the minimum sales volume or number of purchasing units in the tributary area necessary to support a central service function. These concepts of range and threshold are used to determine a hierarchy of central places.

(c). The Central Place Hierarchy

Central places vary in importance and their status is determined by the central service functions they perform. The services and centres are presumed to fall into classes or orders depending on the number and variety of central

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[1]Baskin, op. cit., p. 16.

service functions provided. The assumption is that these discrete groups of centres form a hierarchy so that central places of a higher order or rank contain the central service functions of all the lower orders, plus additional services which distinguish the higher order. Lower class functions are said to "nest" within the functions of higher order centres.

Goods and services of a higher order are demanded less frequently than lower order goods and therefore need trade areas which include larger tributary populations, i.e. greater ranges with higher thresholds. Consequently central places of a higher order have larger umlands and umland populations than centres of a lower order.

(d). Theoretical Location Patterns

Certain geometrical spatial implications derive from these concepts of central place theory. Ideally, before the best spatial formulations can be realized there should be a homogeneously distributed rural population of similar economic means, an absence of physiographic barriers and centres serving non-central or specialized functions, and a ubiquitously distributed transportation network.

Related to the hierarchy of centres is a characteristic areal pattern, as well as a distinctive local population size and a discrete number of centres of each order. Higher order places have larger umlands and

are farther apart and fewer in number. Conversely, commonly-purchased central services characteristic of low order centres can tolerate a smaller trade area so centres providing them will be closer together, generally greater in number and smaller in population. In this way central place theory attempts to account for the size, number and distribution of central places.

Theoretically a large area served by a number of central places of the same order exhibits a series of circular trade areas of the same size equally spaced from one another. However circular umlands are not the most effective geometrical shapes for completely filling an area since tangential circles leave unserved areas, and interlocking rings have zones of overlap (Figure 1).

> Furthermore, the economic range is in reality often smaller than the range of the good itself. Consequently, we can distinguish an ideal range from a real range: the ideal range reaches to the full limit of the range of the central good from an isolated central place, whereas the real range reaches to where the central good can be obtained with greater advantage from a neighboring central place. Segments are everywhere cut away from the ideal circle-forming (isoline) complementary regions of the isolated central place, and these segments belong to the complementary regions of the neighboring central places.[1]

To resolve this problem Christaller formulated hexagonal trade areas to cover completely the plane surface (Figure 2).

The market principle.--The hexagonal tributary areas of the lower orders lie or nest within the spheres of

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[1] Ibid., p. 57.

influence of the larger centres. Centres of higher service status serve larger hexagonal trade areas and will be surrounded on the periphery of their complementary regions by six equally-spaced centres of similar lower order.

In Figure 2 each A hexagon is divided between three B centres, and each B area between three C class central places. The A umland is one-third the size of the B area, and one-ninth the size of the C complementary region.

In this type of pattern the number of central places, the extent of their tributary areas, and the distance between centres of each successive class follows a rule of threes. From high to low order the size of the umlands decreases by a multiple of three, and the distance between centres of a similar rank decreases by the square root of three over distances between places of the higher order. The corresponding number of central places in each grade also follows a ratio of threes--1:2:6:18:54 . . . .[1] The resulting framework does not proceed gradually or along a continuum but in steps from which there may be recognized a hierarchy of centres.

> The system of central places has been developed, on the basis of the range of the central goods, from the point of view that all parts of the region are supplied with all conceivable central goods from the minimum possible number of functioning central places. Therefore, we shall call the principle on which our system has been exclusively developed the supplying or market principle.

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[1]The two highest orders have number ratios of one and two because the originating or dominating centre among the first group of three is elevated to the highest order.

> But there are still other factors, besides the principles in respect to the supplying of central goods, which affect the distribution, number, and size of central places. These are chiefly principles which result from traffic and human social life.[1]

The traffic principle.--Christaller sees the traffic or transport principle affecting the growth and distribution of central places in an area of through traffic on main routes. The orientation of centres becomes more linear than spatial, with as many important central places as possible lying along the major traffic routes. In response to this orientation the hexagonal complementary regions are no longer regular in shape but are shortened on the transportation route and elongated perpendicular to it.[2]

According to the traffic principle central places on straight traffic routes are equidistant from one another, and lower order places lie midway on the sides of the hexagonal trade areas of higher order centres rather than at their apexes as in the market principle distribution (Figures 16 and 17). The size of the complementary regions and the number of central places follow a rule of fours: the hierarchy of tributary areas is 1-4-16-64- . . .; the corresponding number of centres is 1:3:12:48: . . .. Each higher order place is the square root of four times the distance apart of centres of the next lower order.

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[1] Ibid., p. 72.

[2] Note the shape of the trade area for the hamlet of Dublin in Figure 14.

The sociopolitical or separation principle.--This principle operates under conditions which demand institutions to carry out chiefly the functions of defense and administration. Ideally a ring of satellite centres develops around a dominating capital for protection or for the advantages of a strong central government. Each such system of centres is separated from one another by thinly populated or uninhabited areas.

This administrative principle dictates that each higher order centre controls a surrounding ring of six lower order places. It contributes to a number-size-distance distribution according to a rule of sevens.

Because more central places are necessary to supply a region with goods and services in an area influenced by the traffic or sociopolitical principles, Christaller considers the market principle the chief or optimum rule; the other two are axioms of deviation from the marketing or service norm.

3. Methodology of Central Place Theory

This section is devoted to a consideration and evaluation of the techniques that have been used to identify hierarchies of central places, and will serve to explain the selection of procedures used in this study. The methods are based on the theoretical concepts outlined earlier.

The extent to which a community is important in centring on itself the activity of the surrounding area may

be analyzed by investigating the status of its central service functions, or by measuring the magnitude of the area it influences. The former technique involves the concepts of service orders and thresholds, the latter the notion of the range of a good. Another method used in delineating grades of central places is rank-size, which assumes that status is reflected in local population size.

(a). Rank-Size

In assessing the validity of the rank-size procedure, it can be pointed out that the population size of a centre may result from many factors which do not require one to think in terms of a regional market. A centre may secure a large population due to its role as a manufacturing, mining or resort town; none of these functions is intrinsically dependent on the economic support of the surrounding countryside. Local population size may be augmented by the residence in the centre of a retired or commuting component of the population. If communities perform economic activities other than central place functions, they would tend to have greater populations than comparable centres that are not characterized by these specialized roles. Consequently factors outside the influence of central place theory may cause variations in population size and produce a population continuum or size grades which do not correspond to urban function groups.

In order to intelligently use rank-size to indicate status, central places must be differentiated from non-central

places. This is a difficult and highly subjective procedure since nearly all central places contain some vestiges of the specialized functions, and all centres of specialized economic activity contain a complement of central service functions. "Neither area nor population very precisely expresses the meaning of the importance of the town."[1]

A consideration of the relationship between population size and central place status is developed later, but rank-size is rejected as a primary tool for delimiting a hierarchy of central places.

(b). Tributary Areas

One of the basic methods used to establish the existence of urban orders consists of investigating the areal extent and population of trade areas or umlands.[2] This may be done by utilizing the concept of the range of a good, or by evaluating the transportation and communication interactions between the centre and its tributary zone. The measurement of the area dependent on a centre for goods and services involves a number of inherent difficulties.

> Geographers have been demonstrating for a generation that no single area enjoys what O.D. Duncan has

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[1] Ibid., p. 17.

[2] For an example of this method see H. E. Bracey, "Towns as Rural Service Centres: An Index of Centrality with Special Reference to Somerset," Institute of British Geographers: Transactions and Papers, XIX (1953), pp. 95-105.

> recently called 'a complete spectrum of relations' with a central city.[1]
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> The complementary region of a central place is difficult to determine, mainly because its size is different for different types of goods and it undergoes periodic and seasonal variations. Besides that, it consistently overlaps the neighboring complementary regions at its periphery.[2]

That each service has its distinct range may be seen from Figure 3 which indicates non-concurrent umlands for six of the services provided by the town of Wingham. Consistent and considerable overlap of umlands are apparent in Figure 14.

Lack of precision may also stem from the fact that information on the range of a good obtained by interviews or questionnaires will depend on the professional judgment and honesty of the persons contributing the information, as well as on their willingness to release such data. The measurement of trade areas is frustrating to the researcher who desires to spend a minimum of time collecting data and a maximum of time organizing and interpreting it. Conducting interviews to determine the range of goods is a time-consuming process which usually must be limited to daily business hours of retail and service establishments. As a result the number of criteria used to delimit umland boundaries may have to be restricted, thereby inhibiting detailed analysis.

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[1]Robert E. Dickinson, City and Region (London: Routledge & Kegan Paul Ltd., 1964), p. 7.

[2]Baskin, op cit., p. 21.

The significance of central place tributary areas cannot be adequately assessed without the use of an accurate population distribution map, for the extent of the umland will only reflect status in areas of uniform population density.

> Therefore, one cannot determine, merely from the size of the region or from the population of the region, the size of the central place belonging to it. One has to combine these two factors, for there is a functional relationship between the size of a central place, and the size of the complementary region and its population.[1]

In many cases accurate population density maps are not available. The most detailed graphic representation which could be compiled for Perth and Huron counties is shown in Figure 4. The location of householders is a better relative indicator of population distribution than it is an absolute key to actual populations, for when the known census populations are compared to figures calculated from average person per household quotations, errors of from two hundred to five hundred per cent are not uncommon. Such conditions make an exact determination of urban hierarchies from umland populations difficult.

Superior to the method just described is the determination of regional and urban interdependence from an analysis of the amount of communication among centres generated by each activity. Such an investigation would

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[1] Ibid., p. 44.

utilize data on wholesale and retail sales volume, employment figures, public and private transportation movements, telephone communications, newspaper circulation, etc. However, data on the amount of interaction between pairs of centres for each separate activity is not always available, and what must be used is an indication of the aggregate rapport for all reasons. In Europe bus route studies have been used to delineate the extent of a centre's influence.[1] This is a reasonable procedure since in Sweden, for example, ninety-seven to ninety-eight per cent of all passenger movements by road are on buses.[2] However in North America a much greater proportion of passenger movement takes place by means of the private automobile. Between seventy-six and eighty-four per cent of personal trips in Chicago and Detroit are by automobile despite adequate mass transit facilities.[3]

Highway traffic studies do provide information on the action of private vehicles, but these studies involve sampling techniques which are affected by the season and time of day during which samples are taken. Generally there is not sufficient traffic convergence at the lower orders to permit delimitation of traffic divides for these places.

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[1]See F.H.W. Green, "Community of Interest Areas," Economic Geography, XXXIV (July, 1958), pp. 210-226.

[2]As reported by Brian J.L. Berry, "Recent Studies Concerning the Role of Transportation in the Space Economy," Annals of the Association of American Geographers, XLVIII (September, 1959), p. 330.

[3]Berry, loc. cit.

(c). Central Service Function Indices

Christaller used the number of telephones as a measure of centrality on the assumption that this method best represented the tie between a central place and its complementary region. He claimed that telephones were a reliable index of centrality since they represented a common denominator of all business transactions.

Christaller measured the centrality of a place by the formula $Zz = T_z - E_z(T_g/E_g)$ where T_z and E_z are the number of telephones and the number of inhabitants respectively in the place; T_g and E_g the number of telephones and inhabitants respectively in the surrounding area. Zz, the centrality index, indicates the surplus of telephone service the place provides over the local needs of its inhabitants.

When Christaller conducted his investigations in southern Germany telephones were not as common in private homes as they were in business establishments. His index based on the number of telephones in a centre and its district is not as valid today.

A more common method for differentiating classes of central places consists of analyzing the number and variety of central service functions in each place.[1] Direct counts

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[1]See the study by John E. Brush, "The Hierarchy of Central Places in Southwestern Wisconsin," The Geographical Review, XLIII (July, 1953), pp. 395-397.

of the type and number of central service functions are concrete and objective. One of the most appealing aspects of this method is the facility of collecting data. For small places the recording of activities in the field can be done fairly rapidly; for larger centres comparable data are usually available from directories. Since this type of field method is not restricted to normal business hours, it is less rigid than the collection of umland information.

Two complications result from measuring the complexity of a centre's retail and service facilities. First, the amenities offered by a community are operated for the inhabitants of the community itself, as well as the people in the trade area. No satisfactory method has been determined to allow for the separation of services used by urban rather than rural residents.[1] Most investigators using the central service function inventory appear to consider the basic/non-basic ratio as constant for all places. In this instance the umland or telephone index procedures are superior since they emphasize the regional, not urban, dependence on the service centre.

The second disadvantage of this technique stems from the fact that little allowance can be made for the varying sizes of stores (size here is used in terms of sales volume). A simple tally of the number of times that each

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[1]For a discussion of opposing views on the basic/non-basic problem see H.M. Mayer and C.F. Kohn, Ed., Readings in Urban Geography (Chicago: University of Chicago Press, 1959), pp. 85-126.

activity is represented in each community does not reflect the difference in importance between larger and smaller businesses. This difficulty may be somewhat overcome by considering only whether a function appears in a given centre, not how many times the one function is duplicated. The implication in this variation of the inventory approach is that the initial appearance of a central service function is governed by the realization of a certain threshold population in the central place umland. Central place status is determined according to the implied threshold suggested by the appearance of each new type of function, not by the subsequent duplication of the function. Consequently differences in number, size or sales volume for each business need not be considered.

The type of data utilized in the central service function method is the least abstract and most available information for centres in Perth and Huron counties, therefore the cumulative variation of central functions is employed as the primary method for determining central place classes in this study.

(d). Grouping Methods

Within the context of these methods for identifying central place status two basic approaches have been taken to the problem of arranging the centres into discrete groups--the qualitative and quantitative viewpoints.

On the basis of empirical study some researchers have established indicator services which predefine hierarchy levels. For example, a high school might be selected as a criterion for a high order centre and a hardware store for a place of a lower class. Berry has criticized the qualitative or descriptive approach: "One wonders about the value of continued 'a priori' allocations of towns to classes, details of the hierarchy existing by definition alone, when one sees the typical twenty per cent disagreement between classifications."[1]

Other geographers have attempted a more quantitative approach by offering point-scores for the appearance of each central service function or more simply by totaling the central service functions found in each place. Of these studies Smailes and Hartley state: "Quantitative assessments, using total numbers of separate shops, banks, etc., provide too crude a measure, and status must be examined in terms of a qualitative evaluation of service provision."[2]

The quantitative school reaches its height in the use of statistical techniques and mathematical models employing grouping analysis and tests of covariance. While these

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[1]Berry, "Recent Studies Concerning the Role of Transportation in the Space Economy," p. 332.

[2]A.E. Smailes and G. Hartley, "Shopping Centres in the Greater London Area," Transactions and Papers, the Institute of British Geographers, XXIX (1961), p. 202.

statistical methods appear more critically sound than the subjective rank evaluation, their use sometimes results in a lack of communication for geographers unschooled in statistical procedure.

Zobler strikes a key objection to the widespread application of statistical tests to central place studies:

> It is a moot question among statisticians whether whole finite populations may be regarded as samples and submitted to significance tests. Much statistical research is conducted by sociologists on data of this type by assuming that the finite populations are samples from a larger universe.[1]

The term 'population' refers to all possible observations relating to a certain phenomenon. Statistical inference consists of making generalizations about populations on the basis of samples; a statistic is defined as a quantity that is calculated from a sample.

Central place studies typically involve finite populations and not samples; for example, <u>all</u> service centres of Perth and Huron counties are considered in this study. Given the argument that this finite population is but a sample of a larger unit, say Southern Ontario, it must be pointed out that the assumption in statistical reasoning is always that samples are random, i.e. that every element of the population has an equal opportunity of being included in the sample. This condition is not

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[1]Leonard Zobler, "Decision Making in Regional Construction," <u>Annals of the Association of American Geographers</u>, XLVIII (1958), p.142.

met in this thesis since the centres of Perth and Huron cannot be regarded as random choices from all centres in Southern Ontario.

"One thing that should always be remembered is that the selection of a grouping or classification is essentially arbitrary, and that it will have to depend largely on the ultimate purpose the distribution is supposed to serve."[1] In all studies of central place theory the acceptance of a particular set of criteria is an arbitrary, subjective, or qualitative decision. Since statistical summarization often involves some loss of information, one wonders at the efficiency of statistical versus common-sense decisions when sufficient empirical data has been collected.

Christaller also cautions against a mathematically objective approach towards subjective decision-making processes:

> It seems unnecessary to express in mathematical formulas the results discussed in the previous paragraph. The possibility of mathematical expression is self-evident and is easily realized. But in economics, in anthropogeography, and in all the disciplines combined, only a few factors can be given precise values; and since most of these factors are unmeasurable intensities of desire, action, valuation, and comparison,... the mathematical expression of a relationship a priori cannot be exact.[2]

The author hopes to realize an association of qualitative

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[1] John E. Freund, Modern Elementary Statistics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960), p. 14.

[2] Baskin, op. cit., p. 70.

and quantitative methods feeling there is merit in both views, and that the most successful results may come from combining these approaches.

4. Limitations of This Study

Certain conceptual and methodological limitations apply to this study due to the author's approach to theory. The intent in subsequent chapters is to follow the original formulations stated by Christaller despite more recent research which clarifies and resolves many of the problems encountered in this and other studies.

In attempting an application of Christaller's theory to service centres in Perth and Huron counties, the initial assumption is that central place theory is in itself a valid expression of urban spatial relations. From the outset a conscious attempt is made to recognize an urban system in the study area, if not by one method then by another. Consequently one is subject to the legitimate criticism that the results "prove" only what has been assumed from the beginning. Nonetheless the essential aims of this study require an initial framework upon which one can support comments concerning factors of urban location.

Within the context of this basic assumption arbitrary and subjective decisions are made regarding the arrangement of data. The basic approach to a classification of centres

is a qualitative presentation based on a rather simple quantitative record of information. A basic weakness of the method is that the accepted hierarchy is not substantiated by additional and independent evidence such as a study of trade areas.

The contention in the next section of this chapter is that the study area is particularly suited to the application of central place theory. An assumption which is difficult to test is that urban development at the present time has crystallized to the extent that discrete groups of centres may be anticipated. This supposition does not imply that urban development in the study area has been or will be static.

The anticipation of a hierarchy which resembles reality is a product of the author's approach to theory--the central place scheme is regarded as a tool which facilitates the investigation of locative factors affecting urban spatial distributions.

5. The Area Studied--Perth and Huron Counties, Ontario.

Figure 5 shows the location of Perth and Huron counties in Southwestern Ontario, a region which Putnam says "represents old rural, agricultural Ontario."[1] This region has remained peripheral to the mainstream of industrial and urban development in Southern Ontario. From the time of the fur trade Perth and

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[1]Donald F. Putnam, Ed., Canadian Regions (Toronto: J.M.Dent and Sons, Ltd., 1952), p. 290.

Huron counties have been slightly north and west of the avenues of Canadian transportation and trade in the immediate lowlands of the Great Lakes-St. Lawrence route.

(a). Physical Summary

Physically these two counties are part of a high plain ranging from 600 to 1375 feet, with approximately three-quarters of the area over 1000 feet above sea level. The gently-dipping limestone bedrock is deeply covered with either glacial drift or old glacial lake deposits. The physiographic regions, adapted from Chapman and Putnam[1] are indicated in Figure 6. Over three-quarters of the area is flat to gently-undulating till plain. With the exception of shore bluffs along Lake Huron and a few incised streams within three miles of the lake, local relief seldom exceeds fifty feet. A detailed discussion of the physiography and its effects on urban location is included in Chapter V.

The soil types closely reflect physiographic regions. Limited areas of coarse-textured, well-drained soils overlie the sand plain along Lake Huron. The northern one-third of Perth and Huron counties has predominantly medium-textured soils with good drainage. The remaining and largest soil association is of fine-textured soils formed on till or lucustrine sediments. The major soil types in this group

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[1]L.J. Chapman and D.F. Putnam, The Physiography of Southern Ontario (Toronto: University of Toronto Press, 1951).

have imperfect drainage. Small isolated areas of poorly-drained organic soils occur within the two counties (Figure 6).

(b). Economic, Transportation and Population Features

A summary of areal, population and economic features of Perth and Huron counties is presented in Table 1. The agricultural statistics are shown as the rank in a total of fifty-four counties in Ontario for the categories selected from the 1961 census.

At the time of the census Huron county had a predominantly rural population with only thirty-four per cent of the population living in urban communities. The population of Perth was more evenly divided into rural and urban groupings. In Huron county the largest part of the labour force was engaged in agriculture with only twelve per cent in manufacturing. In Perth county both agriculture and manufacturing engaged twenty-five per cent of the labour force.

The data in Table 1 indicates the significance of stock-raising in the agricultural economy of these two counties, with an emphasis on beef cattle in Huron and dairy cows in Perth. The latter county is also the leading producer of hogs in Ontario.

Although Perth and Huron counties are peripheral to the main traffic routes in Southwestern Ontario between

Toronto and Windsor (Figure 5), both road and rail transportation are well developed and uniformly distributed within the study area (Figure 7). Both urban and rural areas are provided with transportation systems ranging in condition from good to excellent. In addition to the railways, provincial highways and county roads shown in Figure 7, a dense network of gravel township roads serve the counties.

Preliminary investigation of Perth and Huron counties indicates that this area is ideally suited to the application of central place theory. The two counties lack major topographic barriers and many centres of obviously specialized function. Figures 4 and 7 reveal a relatively uniform population and transportation distribution, and the latter map shows evidence of a fairly regular spacing of urban centres suggestive of the implications of central place theory. Communities in this area have been described as "a number of smaller towns which serve as local market centres and supply points."[1]

(c). The City of Stratford

The dominant urban centre in the study area is the City of Stratford. Its population of 20,500 in 1961 was greater than the total urban population of Huron county and almost as great as the total rural population of Perth

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[1] Putnam, op. cit., p. 290.

county. Stratford is an important manufacturing centre; the industries of Stratford produced $49,700,000 worth of manufactured goods in 1961, well over one-half of the total for Perth county. It is the site of the Stratford Shakespearean Festival which attracts an estimated three hundred thousand tourists every summer. Ticket sales for the Festival approximated $1,000,000 in 1963; associated tourist spending was estimated at an additional $2,000,000. Its large manufacturing and tourist base indicate that Stratford is an urban centre with specialized functions perhaps more important than its central place role.

Figure 8 shows past population trends in Perth and Huron counties. Median population growth for twenty-seven townships and sixteen urban centres may be compared to Stratford's population expansion during similar time periods.

Since the primary function of central places is to serve the rural countryside, their populations should reflect the farm population history of the area. Stratford has experienced a steady and strong increase and is the only centre which does not exhibit the general decline of population in 1881. A previous study of the city of Stratford has suggested that this centre's population has continued to grow in almost direct proportion to the increase in the manufacturing function.[1]

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[1] J.W. Hamilton, "Stratford, An Urban Study" (unpublished B.A. dissertation, Dept. of Geography, University of Toronto, 1943).

Central place theory cannot adequately accommodate large urban centres whose major economic base is not the central place function. The additional services introduced by Stratford's large size and specialized roles may disproportionally affect the classification of central places. For this reason Stratford is excluded from initial tabulations of central service functions, but the character and influence of this centre, and its position in a central place hierarchy are considered in Chapters III, IV and V.

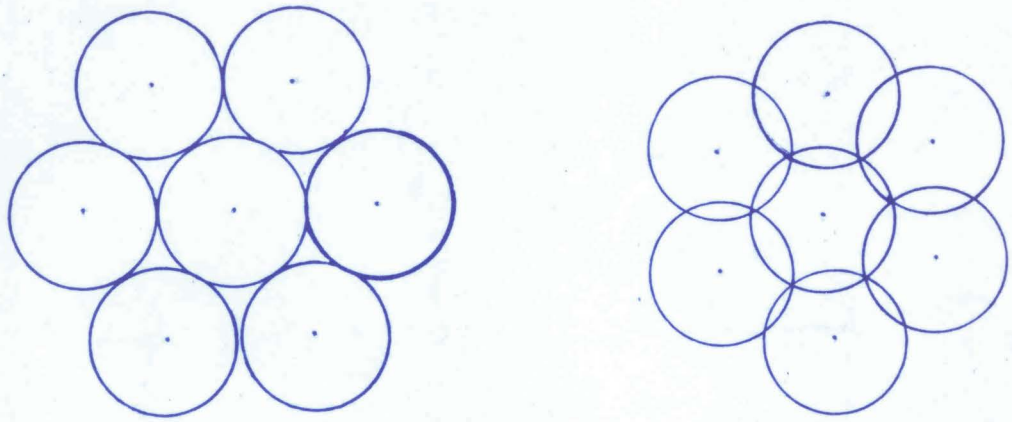
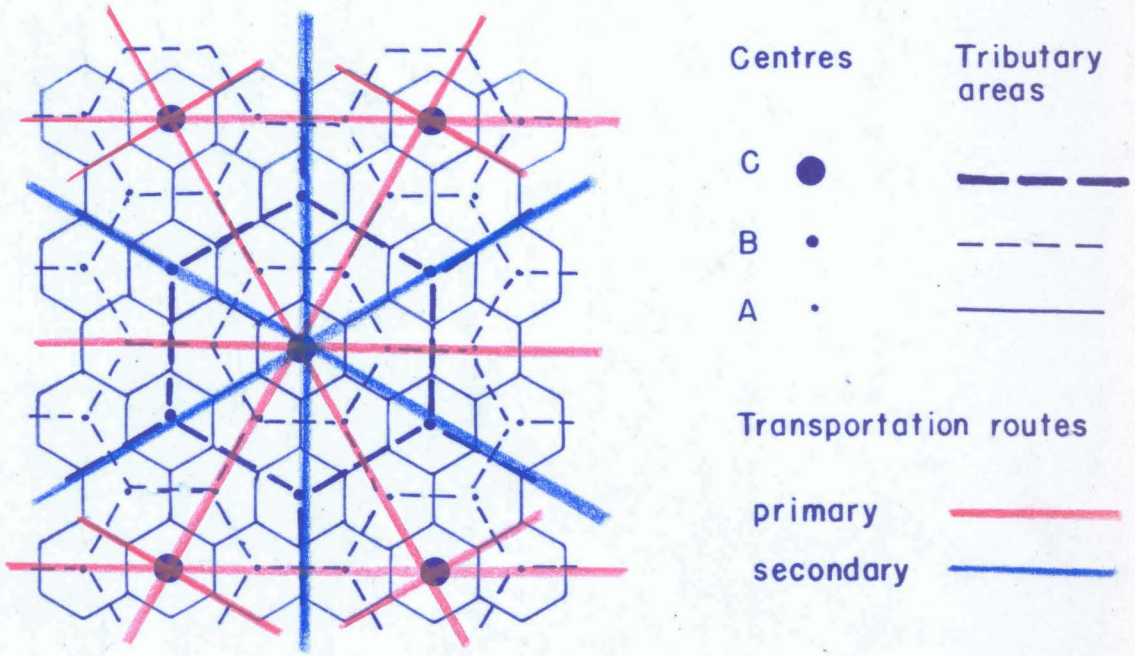


FIG. 1. Circular trade areas with unserved and overlapping zones.

FIG. 2. The hexagonal hierarchical system of centres and transportation routes.



Hardware — Telephone exchange area

Jewellery — Rural route postal service

Bank — Newspaper

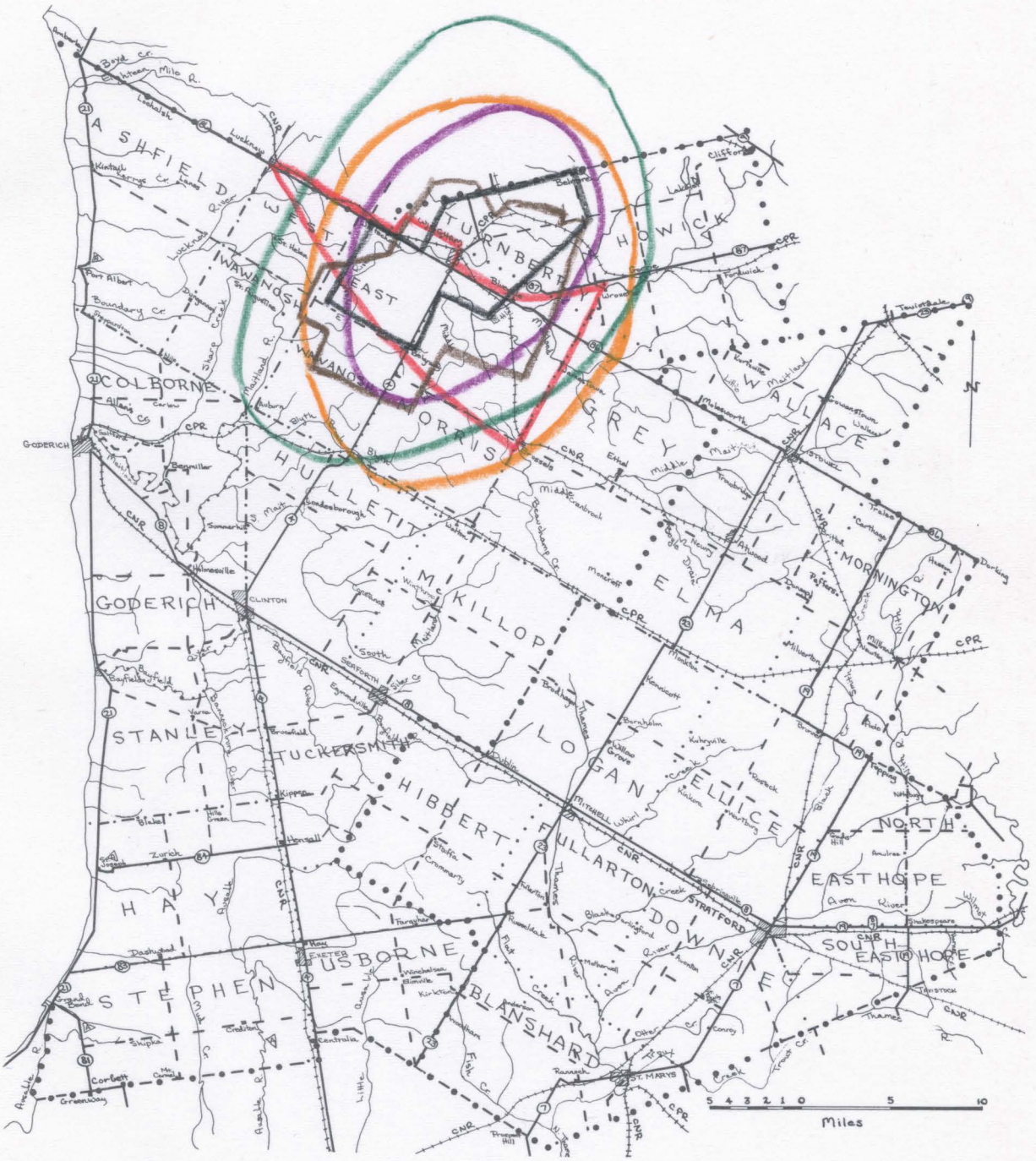


FIG. 3. Wingham trade areas

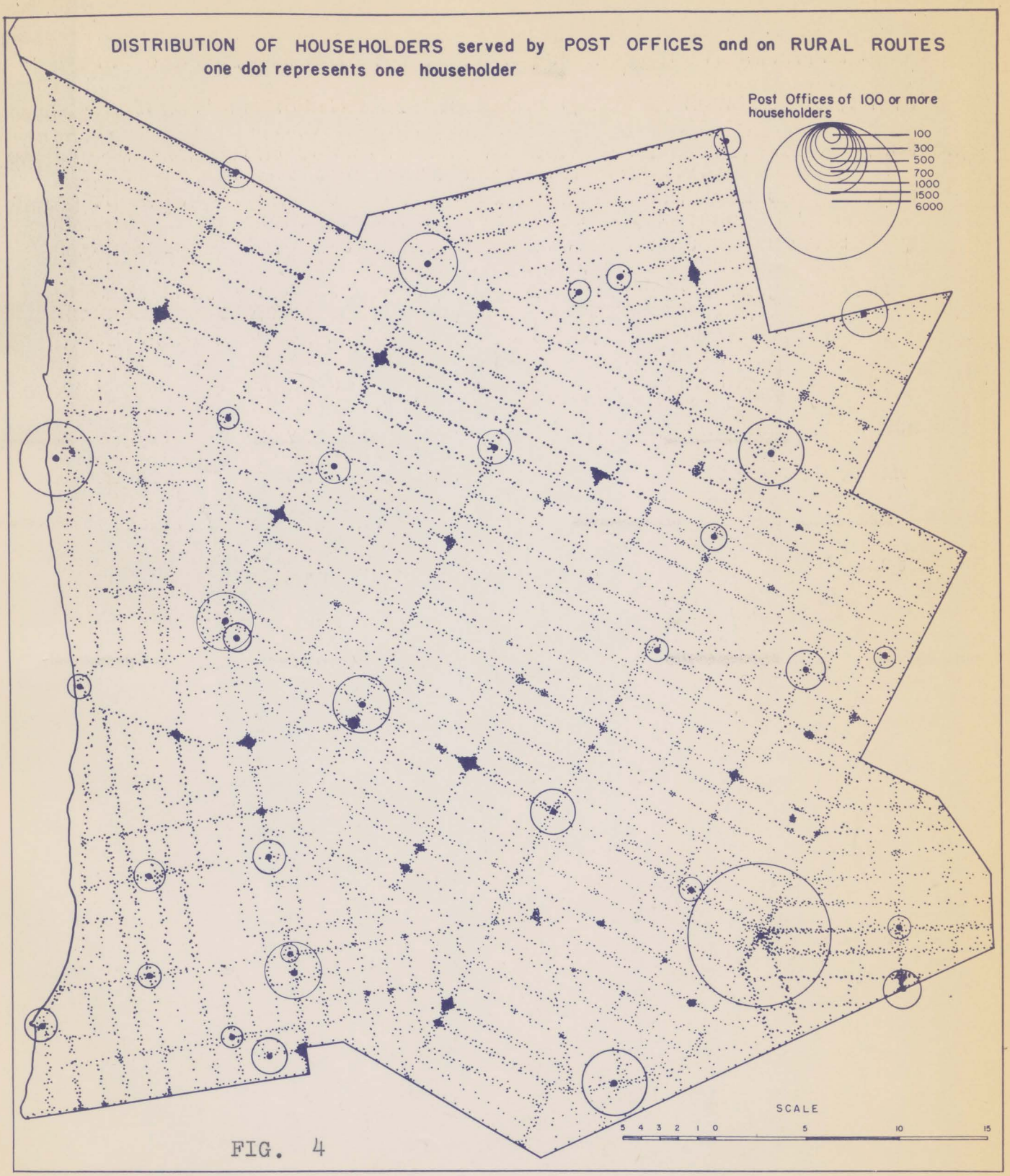

DISTRIBUTION OF HOUSEHOLDERS served by POST OFFICES and on RURAL ROUTES
one dot represents one householder
Post Offices of 100 or more householders
100
300
500
700
1000
1500
6000
SCALE
5 4 3 2 1 0 5 10 15

FIG. 4

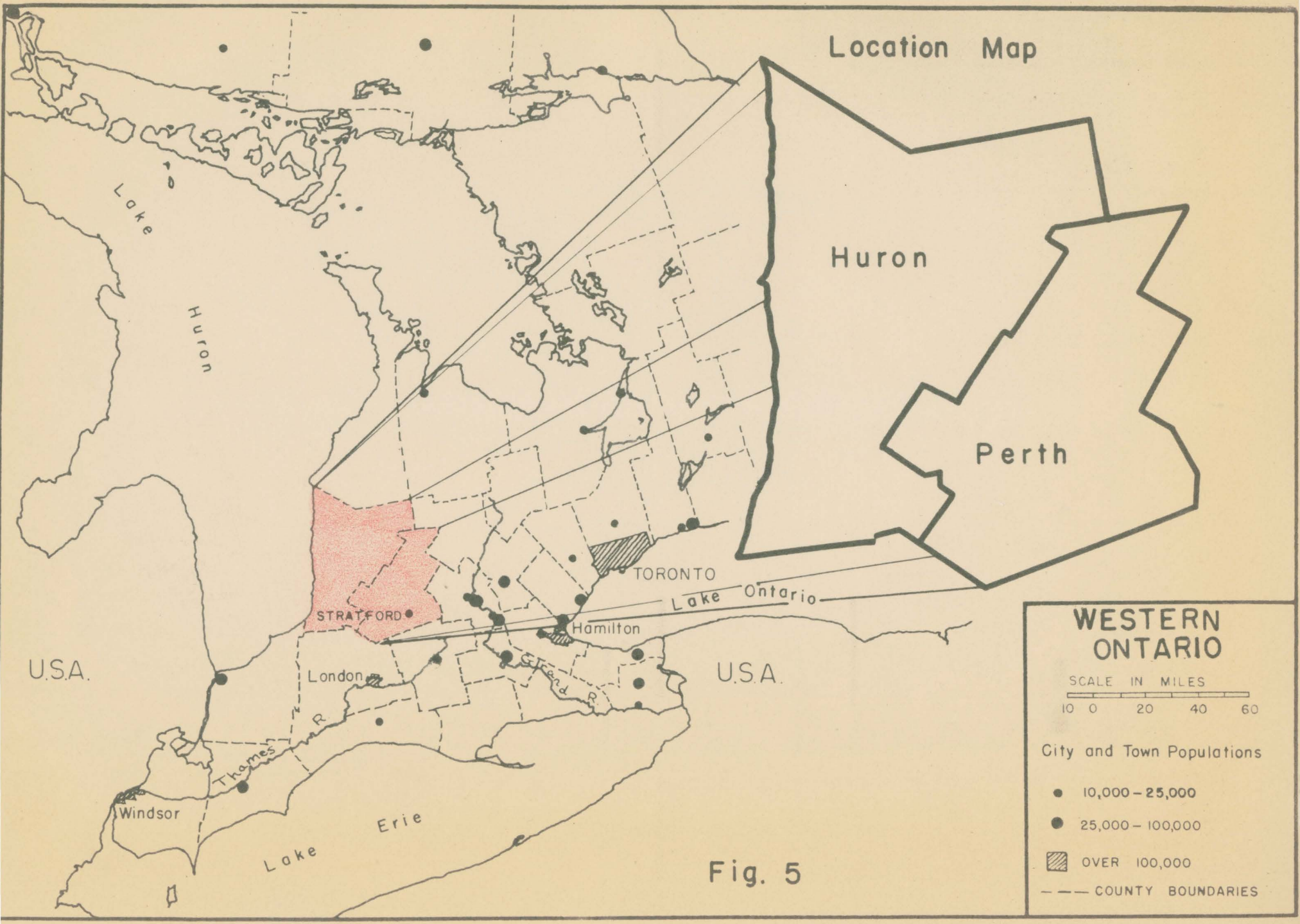

Location Map
Huron
Perth
Lake
Huron
TORONTO
Lake Ontario
STRATFORD
Hamilton
U.S.A.
U.S.A.
London
Thames R.
Grand R.
Windsor
Lake
Erie
WESTERN ONTARIO
SCALE IN MILES
10 0 20 40 60
City and Town Populations
10,000 – 25,000
25,000 – 100,000
OVER 100,000
COUNTY BOUNDARIES

Fig. 5

Till and kame moraine

Till plain and spillway

Sand plain

Marsh

Drumlinized area

FIG. 6 Physiographic regions

adapted from Chapman and Putnam

TABLE 1

ECONOMIC AND POPULATION FEATURES
OF PERTH AND HURON COUNTIES

	Huron	Perth
Area	1295 sq. mi.	840 sq. mi.
Rural population[a]	35,679	24,473
Urban population	18,126	32,979
Population density	41.54	68.39
Value of livestock and poultry	1st	2nd
Total cattle	1st	4th
Milk cows	3rd	2nd
Total hens and chickens	1st	2nd
Mixed grains	2nd	1st
Tame hay	3rd	4th

[a]Rural population includes all those living outside of municipalities in excess of 1000 inhabitants.

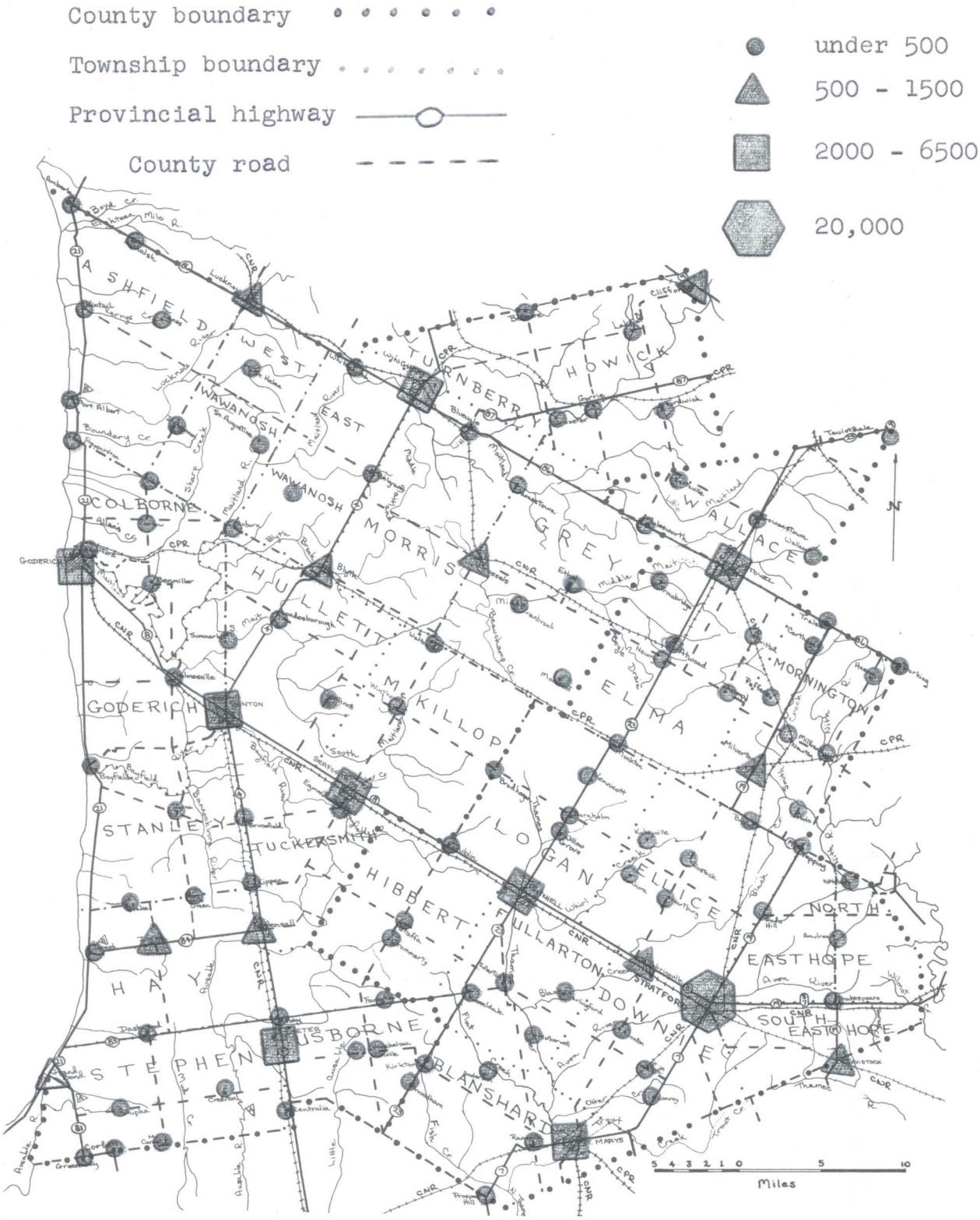


FIG. 7. Index map

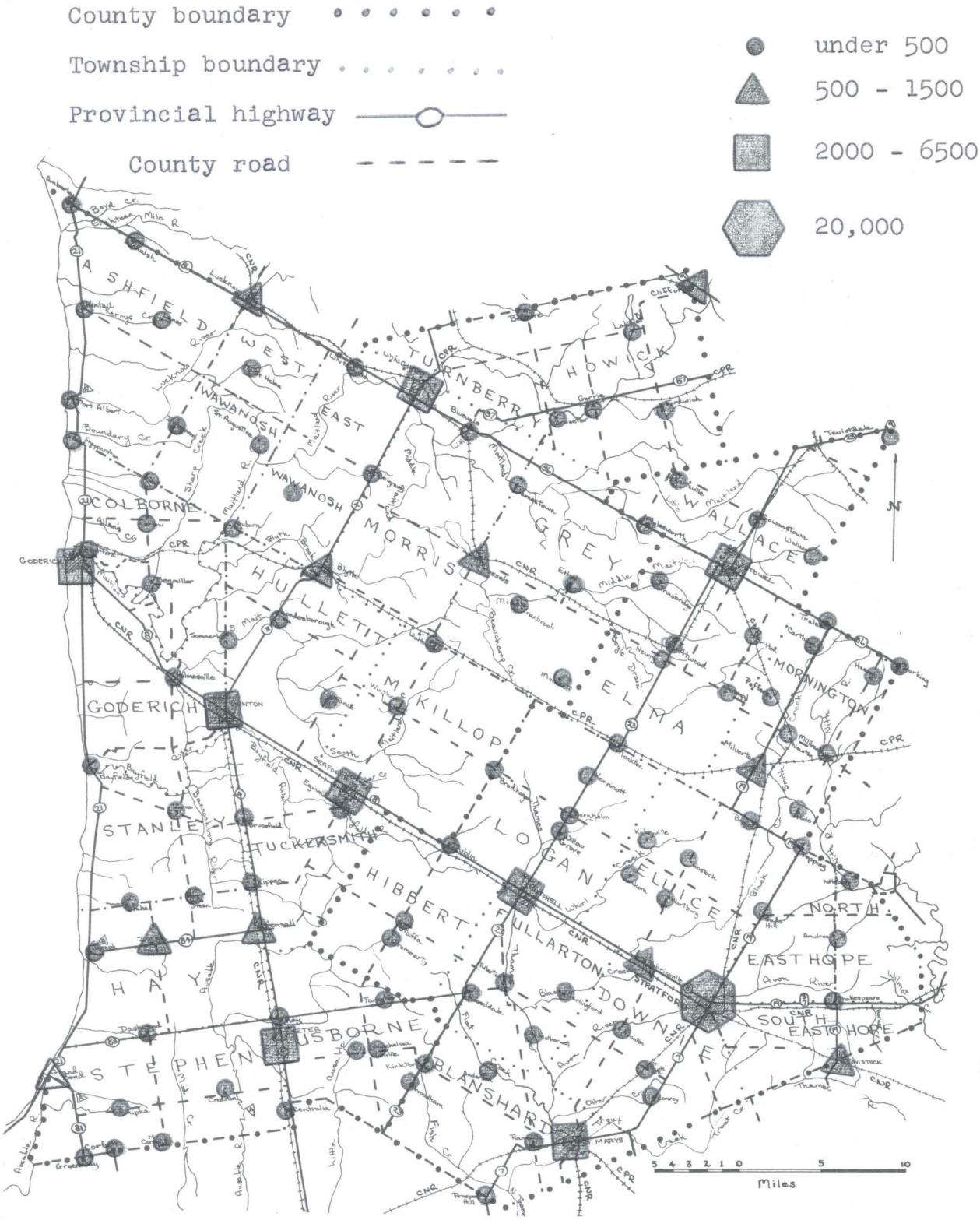
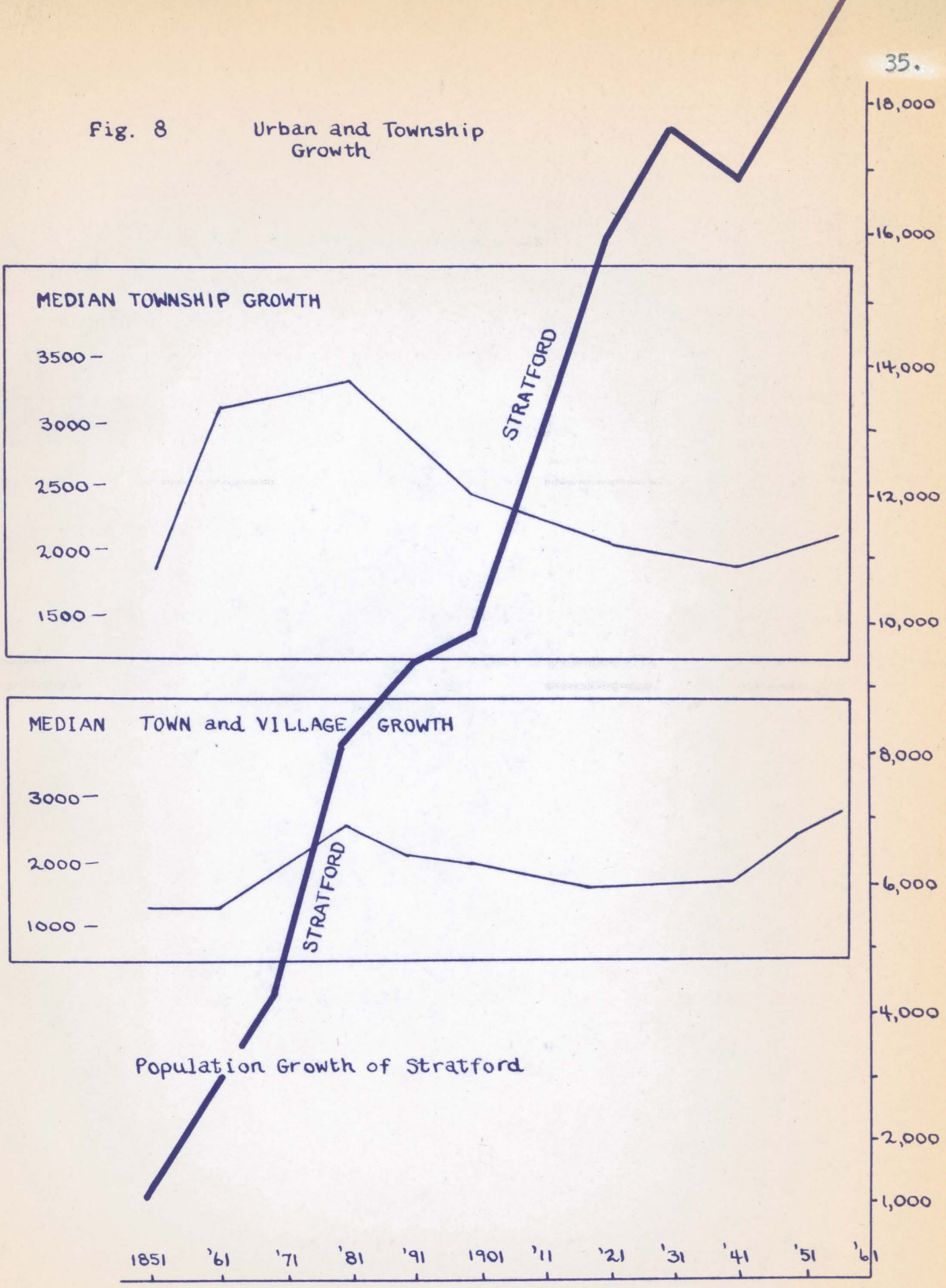


FIG. 7. Index map

Fig. 8 Urban and Township Growth



Population Growth of Stratford

CHAPTER II

PROCEDURES

1. Definitions

(a). Central Places

In previous papers "central places" have varied in size from farm houses to metropolitan agglomerations. In order to avoid the controversy as to the magnitude of settlement units needed to constitute a place, at least one commercial unit or mercantile establishment is accepted as the definition in this study.[1] It is assumed that even the smallest retail or service distributor draws a certain amount of business from a surrounding area. The only commercial establishments that have been disregarded as foci for central place development are isolated automobile service stations, cafés and motels on major highways in areas with no evidence of agglomerated settlement, now or in the past. Since the emphasis in a later chapter is historical, a valuable guide to settlement locations has been place names on present and early maps.

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[1]Hans Carol states that a central place can be the location of a single central function or a group of central functions. See Hans Carol, "The Hierarchy of Central Functions within the City," Annals of the Association of American Geographers, L (1960), p. 420.

(b). Central Service Functions and Functional Units

The determination of a hierarchy of central places is attempted by an analysis of the functions performed by the centres of Perth and Huron counties. A function is defined as one retail or service activity. A central service function is a service or retail activity thought to be characteristic of central places. These functions are considered to be non-local in that they have been established to serve the needs of the centre's tributary area and do not exist primarily or exclusively for the convenience of the inhabitants of the centre. The designation of functions as "local" and "non-local" in influence is a difficult task. Consequently the author referred to classifications of central functions used by researchers in the central place field.[1]

Many places have more than one representative of a given activity, for example, two service stations or six food stores. Each occurrence of the same function in the same centre is termed a functional unit. Usually a functional unit can be considered as the physical manifestation of a retail or service activity, ie. the building in which it is located. Occasionally two functions will occupy the same building; many of the smaller furniture dealers in Perth and Huron counties are also local funeral directors. Both types

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[1]Particularly Brian J.L. Berry and William Garrison, "The Functional Bases of the Central Place Hierarchy," Economic Geography XXXIV (April, 1958), pp. 145-54.

of merchandise are displayed on the same premises. A double function within a single business unit is considered to have a lower threshold than a single function in a single unit. To facilitate mathematical computation two functions sharing the same building (management, staff, etc.) may be considered to represent at least one but not quite two functional units. The numerical symbol used to express this situation is one and one-half functional units.

(c). The Selection of Central Functions

The service data for central places was collected through field study by complete traverses of the twenty-seven townships of Perth and Huron counties in April and May, 1963. Information on the professional services could be accurately determined from telephone and professional directories. However the sizes of central places in the study area do not lend themselves to complete investigation from secondary sources, so it was necessary to visit each place to compile or confirm source material.

In Table 2[1] fifty services are designated as central service functions and ten additional items are shown as non-central functions and attributes. This initial division was intended to attempt a separation of indices of a central service role and indices of status rather than service.

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[1]Table 2 may be found in the back-cover envelope.

Many types of non-central functions occur with regularity and demonstrate characteristics of central service functions although they are technically not retail mercantile establishments. The feed, seed or grain mill is a manufactory which provides a service to a local area in the same way that many central services do. Government offices and public utility commissions may provide services directly to the public, but usually they imply a headquarters organization reflecting the relative importance of the community. The post office and telephone exchange are listed as attributes because a distinction is made between different types of these services each of which is considered to imply status more than service. "Legal incorporation" is an attribute which implies status but does not connote a service function.

Because indices of status and service can both contribute to recognition of urban grades, the separation of functions was subsequently abandoned, and all 60 items in Table 2 were collectively called "activities". Since unsuccessful attempts at ranking central service functions are recounted in a later section, the original division is preserved in the chart.

Some activities encountered in visits to service centres are not recorded in Table 2 because of certain difficulties in location or classification. Many churches

and schools could not be assigned to communities because they were found in isolated locations away from agglomerated settlement, presumably because they were situated where land was donated or could be purchased most cheaply. Fuel distributors often have isolated locations seemingly unrelated to a particular community. The remaining services were difficult to classify because they were such minor subsidiary activities of many other retail or institutional establishments. These included appliance repair, meeting halls, sports and cycle merchandise, real estate agents and cleaners.

Certain service designations in Table 2 warrant further explanation. The category called "soft furnishings" refers to a retail shop providing, separately or in combination, carpets, draperies and upholstery material. Branch offices of banks and law firms, and different classes of post offices and telephone exchanges were also delineated in Table 2. The letter "B" denotes branch law offices and banks. Telephone exchanges are differentiated by the letters "B" and "L", referring to the extensive Bell Telephone System and local smaller companies respectively. Two classes of post offices are shown: "II"--post offices which can receive C.O.D. parcels and collect charges, "I"--post offices which have in addition a savings bank office.

2. Ranking Activities

Table 2 shows the fifty central service functions and ten attributes arranged according to their frequency of occurrence throughout Perth and Huron counties. Activities are graded on the basis of whether a function occurs or does not occur in a place, and not on the number of duplications of one service type in one centre. The numerical values assigned to the functions in each centre are the functional units defined earlier.

It should be noted that a few central functions such as "Government liquor store" do not vary in number from centre to centre. Most attributes do not display the range in functional units exhibited by central service functions.

In general the number of functional units for a given service increases with increasing central place size or importance. However some services appear to experience expansion rather than duplication in larger centres. Listowel and Wingham have four and nine food stores respectively, but three of the stores in the former centre are supermarkets.

Because functional units do not always reflect the increasing importance of service centres, the type and not the quantity of service in a community will be used as the fundamental expression of centrality.

3. Unsuccessful Attempts at Ranking Central Functions and Central Places

In order to assess the effects of different approaches to the same collection of functional data, a number of different methods for determining clusters of activities and central places was attempted.

(a). Functional Units and Threshold Values

Although the functional unit was not employed as a primary tool for ranking service centres, it was investigated as a method for deriving central service groups. For each service one can compare the total number of functional units to the number of centres in Perth and Huron and assume a critical threshold value for the appearance of each service.[1]

Central places are arranged in descending order of importance according to the number of activities in Table 2. The functional unit total for a service is counted off for each centre beginning with the most important place. When the centre corresponding to the functional unit total is reached, it is assumed that this centre represents the threshold activity value for the appearance of the first service or good of this type in Perth and Huron counties. A similar procedure is conducted for places arranged in descending order according to local population size.

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[1]For a review of the threshold concept refer to Chapter I, section 2(b).

The function "Shoe store" from Table 2 will be used to illustrate this technique for ordering central service functions. Twenty-nine shoe stores occur in fourteen centres recorded in Table 2. Counting in descending order from Goderich, the twenty-ninth centre is Bayfield with an activity total of twelve. When centres are arranged in descending order according to population size, the twenty-ninth centre is Fordwich with a population of 267. Thus the activity and population threshold values for "Shoe store" are assumed to be 12 and 267 respectively. The results of this type of investigation for central service function are shown in Appendix I.

Attempts were made at grouping these indices and at assigning central places (ranked according to population, total central service functions or total activities) to these functional groups. The proportion or percentage of central places which could be associated according to rank with the threshold groups was found to be low in all cases. This situation contrasts with the high proportion of activities related to central place sets which results from the method described in the last section of this chapter.

The difficulty associated with this method was ascribed to the problems inherent in the use of functional units discussed in the previous section, specifically the lack of an exponential or arithmetic increase of many functional

units from low order places to centres of a higher order in Perth and Huron counties.[1]

(b). The centrality Index

The arrangement of central service functions in Table 2 indicates an increasing specialization of service with decreasing frequency of occurrence of functions. The shops which occur least frequently (music and book stores) are, by common experience, those which appear in highly specialized shopping districts. The frequency distribution in Table 2 is constructed on the premise that functions which are numerous and widely scattered are less central than services concentrated in a few localities only.

On the basis of this premise it was possible to develop a weighted index for all central service functions which expressed the degree to which each service correlates with demand. Whereas the original ranking scored each service a value of one point, this system assigned a greater numerical value to the more important functions.

This importance index, called the index of specialization, has a rather simple derivation. The significance of each central service function is indicated by relating the number of communities with the function to the total number of centres in the study area. A food store appears in 113 of

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[1]Compare the functional unit values in Table 2 with those compiled by Berry and Garrison for Snohomish County where an exponential relationship was found for most activities in different central places. Ibid., pp. 149-50.

the 118 places studied; its index of specialization is 118/113 x 100. Banks occur in 35 of the 118 centres and have an index of 118/35 x 100. Thus the index is a percentage of the reciprocal frequency of occurrence of functions in the study area, and increases with increasing specialization of central service functions.

The specialization indices for the functions in a central place were summed to give an index representing the cumulative complexity of the functions in the centre, an index referred to as the centrality index. The results of ranking central places according to this weighted functional value are discussed in the next section which deals with a refinement of this technique.

(c). The Mean Centrality Index

The method outlined above takes into consideration the frequency of occurrence of the central service function throughout the study area. The specialization index for a food store in a centre with fifty functions is identical to the index in a place with only one other function. Some adjustment seemed necessary to compensate for the fact that each common function such as food store becomes relatively less important in larger centres.[1] The value indicating the importance of the central service function in the region could be moderated by a value reflecting the proportional importance of the service to the centre in which it occurs.

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[1] This is indicated by the increases in the number of functional units.

The new index for a food store in a centre with fifty functions becomes 1/50 ÷ 113/118, and for a food store in a place with two functions 1/2 ÷ 113/118. When the new specialization indices are summed to produce a centrality index for a centre, the new centrality index is found to be simply the average of the specialization indices of that centre. Thus for the fifty central service functions of Goderich, the centrality index could be computed as follows:

$$\frac{\frac{118}{113} + \frac{118}{80} + \frac{118}{38} \ . \ . \ . \ \frac{118}{3} + \frac{118}{1} + \frac{118}{1}}{50} .$$

Since each central place could be assigned a mean centrality index, Dixon's criteria for testing for the extreme mean could be utilized to relegate centres to groups.[1] This technique tests whether or not the largest or smallest observation is sufficiently far removed from its nearest observation to indicate that the extreme value is from some other group or set of observations.

The means tested were the new centrality indices of the central places, or rather the centrality indices which occurred after rather prominent gaps between ranked centrality values. The object was to determine whether these breaks were significant and warranted consideration as the limits of sets of service centres. An illustration of the procedure involved is outlined in Appendix II.

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[1] W.J. Dixon and F.J. Massey, Introduction to Statistical Analysis (New York: McGraw-Hill Book Co., Inc., 1951), pp. 145-146.

Both methods utilizing weighted centrality indices tended to inflate the values for centres with specialized (non-central) roles such as Grand Bend, a resort, and Sebringville, a dormitory village for Stratford. These places were elevated to positions which would be inconsistent with other centres in a purely central place hierarchy.

Both procedures produced values which tended to isolate centres in one or two-member groups, groups containing places which did not seem dissimilar in most respects from members of some other groups. In the description of the extreme mean technique in Appendix II, Wingham is indicated as having a centrality index significantly different from the values of other centres included in the C group of Table 2. An investigation of the functional traits of the C group does not seem to warrant such a conclusion.

The rather involved "number juggling" and sophisticated grouping analysis used above did not aid in resolving central places into an ordered hierarchy which seemed relevant to raw data collected in Table 2. Consequently a more simple and direct method for grouping central places was employed.

4. The Ranking of Central Places

> As to the size-types of the central places, the sizes i.e., the importance) of the places are determined mainly by the number of types of central goods which is offered.[1]

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[1] Baskin, op. cit., p. 120.

Since the fifty central service functions listed in Table 2 did not prove effective in differentiating central place groupings, the ten non-central functions and attributes were also considered. It has been pointed out that some of these traits do provide a service role.

When the central and non-central service functions are considered together as activities, central places may be scaled according to the cumulative complexity of their activities. Goderich has all the fifty central service functions and the ten non-central functions and attributes; it is given an activity value of sixty and appears as the most important centre in Table 2. Similarly other centres are graded according to the total number of the sixty activities and this value is indicated below each place name at the top of the table.

To establish the existence of discrete groups, orders, classes or sets of central places, it was decided that any ordering of centres should correspond to the type of grouping analysis forwarded by Clark:

> It is convenient to define a group as a collection of points in which every individual is closer tosome member of the collection than to any individual outside of it. The concept of a group as so defined, is a hierarchical one, large groups containing smaller ones within them.[1]

If distinct sets of centres are to be found in a progressive continuum of central places, significant breaks should

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[1] P.J. Clark, "Grouping in Spatial Distributions", Science, CXXIII (1956), p. 373.

appear in the linear gradation represented by the activity totals of each centre.

Figure 9 shows the scatter distribution of the central places arranged according to total number of activities and local population. The population of these centres is plotted to determine the applicability of rank-size in recognizing a hierarchy of service centres. Population statistics from the 1961 census report were available for all but fifty-eight of the smallest centres, all of which were presumed to be under one hundred people. Indications are that these unplotted values would form a population progression at the lower end of the scale, and they do form a functional progression from one to five activities (see Table 2).

Two major intervals in the continuum of activity totals occur at the fifteen to twenty, and thirty-eight to forty-six activity levels; these have been emphasized by the vertical dashed lines in Figure 9, and the central place sets designated A, B and C centres. The clustering of these central places into three classes is consistent with Clark's definition of a group.

On the other hand, discrete population clusterings occur only at the highest levels; these intervals are accentuated by horizontal dashed lines in the diagram.

The easy resolution of all places into definite sets

would not have been possible if the study region were not rigidly confined to the political entities of Perth and Huron counties. The town of Palmerston is on the border of these counties (marked with a "?" in Figure 10) and its trade area extends into the study area (Figure 14), but technically it does not belong to either county. If Palmerston were considered, its forty-two activities and population of 1554 would place the centre just midway between the B and C classes (shown as P in Figure 9), thus complicating the determination of central grades by forming a continual rather than a step-like progression of activity values.

The technique employed above is a quantitative procedure designed to provide a preliminary ordering of central places which will facilitate systematic study. In the following chapter a qualitative or descriptive approach is undertaken to determine whether a three-fold ordering of central places is justified on the basis of characteristics common to each class.

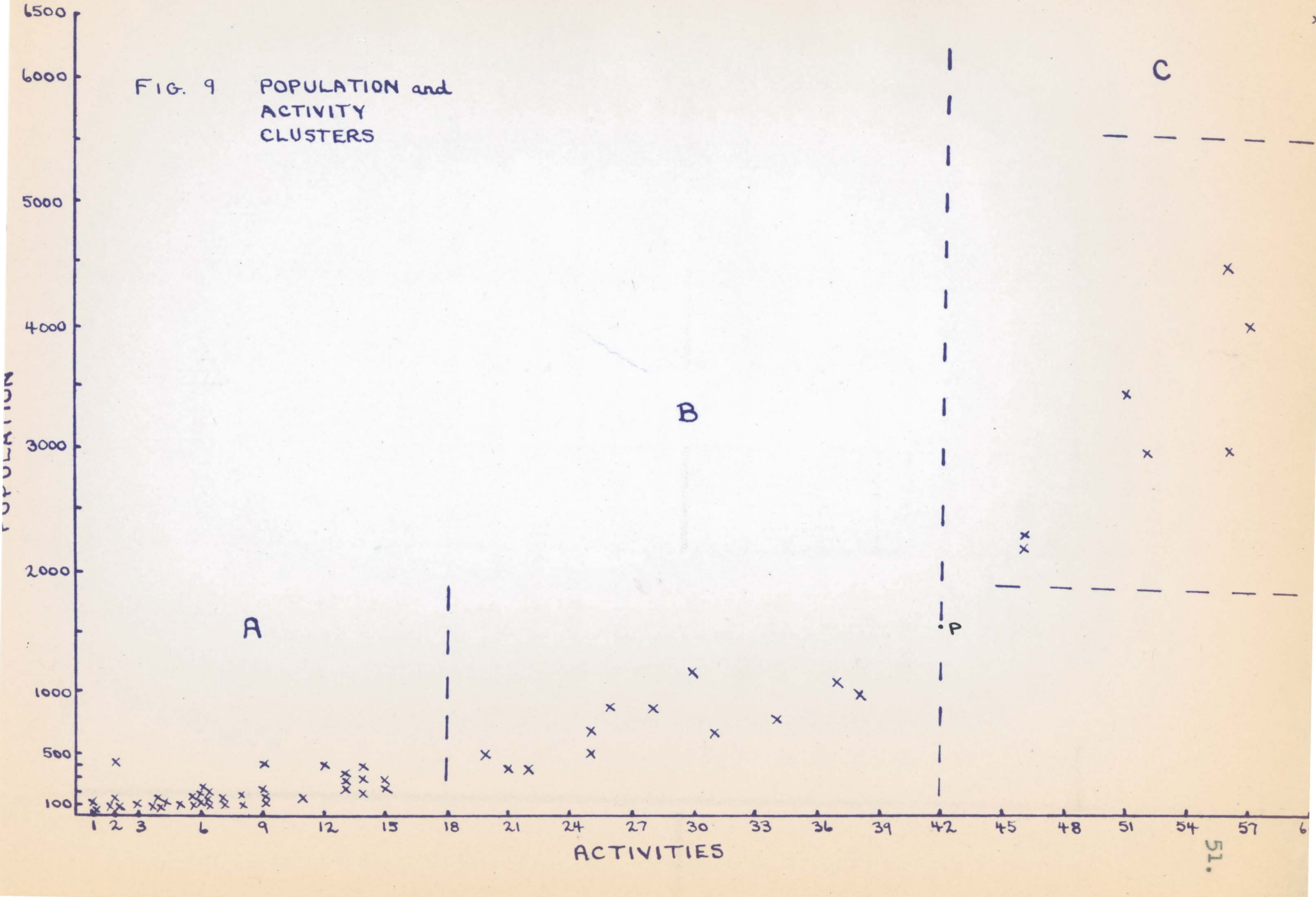
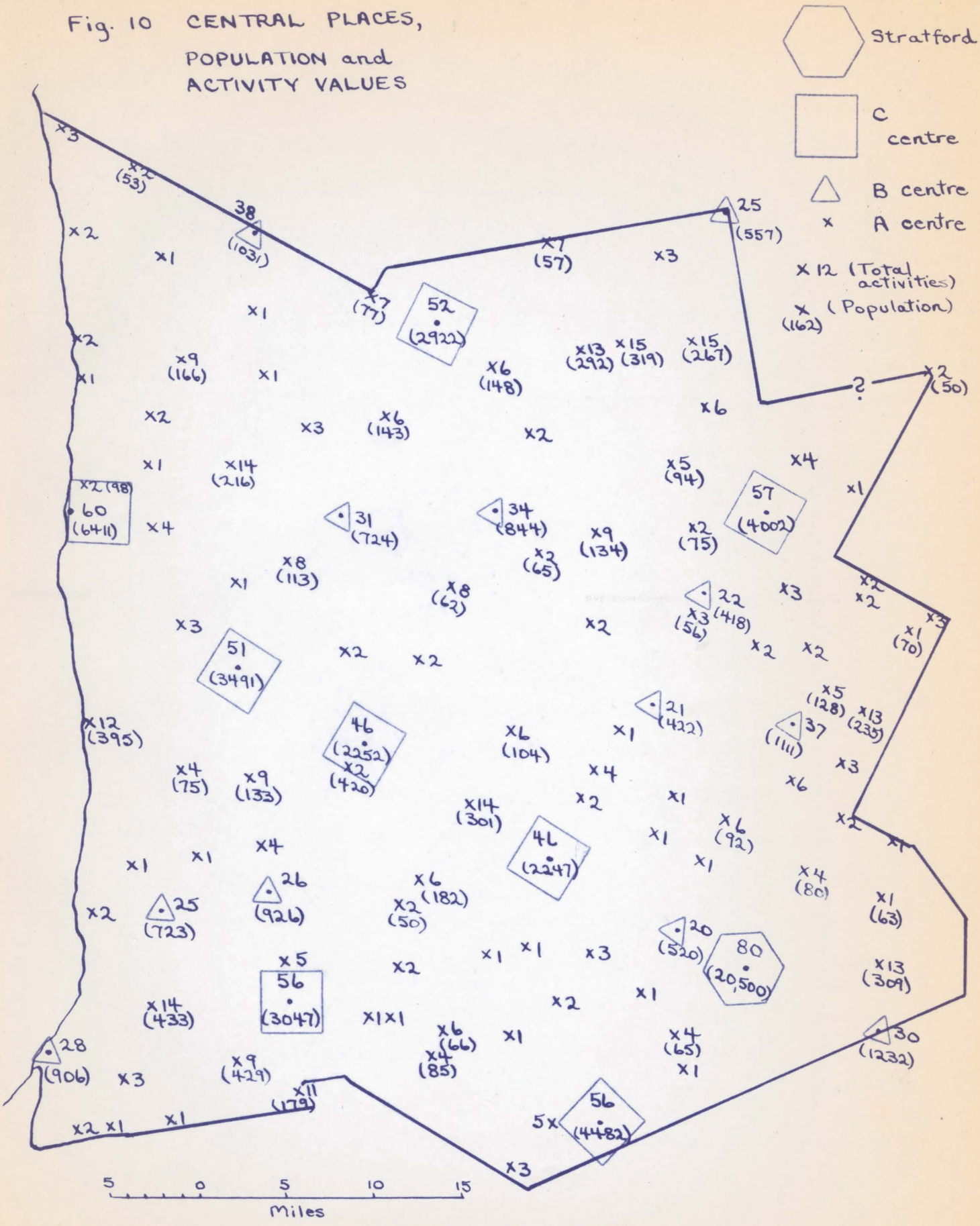


FIG. 9 POPULATION and ACTIVITY CLUSTERS
6500
6000
5000
4000
3000
2000
1000
500
100
POPULATION
A
B
C
P
1 2 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 6
ACTIVITIES

Fig. 10 CENTRAL PLACES, POPULATION and ACTIVITY VALUES



CHAPTER III

DESCRIPTIVE ANALYSIS OF CENTRAL PLACE ACTIVITIES AND CENTRAL PLACE ORDERS

1. The Ordering of Central Service Functions

The next step in the process of confirming the central place hierarchy suggested in the last chapter would be to show that a class system of centres follows from an ordered gradation of service functions. However central service functions do not fall into convenient constellations directly related to the sets of central places. The total number of places in which a central service function appears is shown in the column to the right of each function in Table 2. These totals form a regular progression with the only notable interruptions isolating "Food stores" and "Automobile service stations". While it is apparent that there are very great differences between service provision in the upper and lower parts of the scale, over most of the range clear steps are absent.

The ordering of central service functions based on groups of central places does not directly follow because the hierarchy or nesting concept does not rigidly apply. All centres of functionally more complex orders do not

possess the entire assemblage of functions contained in lesser centres, and some of the latter places have a few central service functions characteristic of much higher groups.[1] These service anomalies prevent a direct correlation between ordered central places and central service function classes, but more general relationships may be summarized by a careful examination of Table 2.

2. Relegation of Activities to Central Place Orders

(a). Definitions

In Table 2, a number of functions appear to be characteristic of C and B centres, and of no other places of a lower order; hospitals, for example, occur only in the C group. Official village incorporation is the only similar characteristic exclusive to B centres. Since nine of the twelve villages are incorporated, this ratio was selected as a convenient means of designating functions which are exclusively characteristic of an order. An "exclusive" function is an activity or attribute which occurs in seventy-five to one hundred per cent of centres in one class, and which does not appear in any other group of centres.

Although selection of the seventy-five per cent figure is a subjective and arbitrary choice, it is useful in delineating a large number of functions within as high

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[1] Bluevale, a centre with only six activities, contains a music shop, a service typical of the two most populous centres.

a proportion of centres as possible. It is a feature of central place theory that the acceptance of a particular set of criteria is an arbitrary decision made in order to acquire convenient categories for empirical data.

Trial and error operations with the distributions in Table 2 led to the following definitions of full and partial complements. A "full complement" refers to a function or attribute occurring in seventy-five per cent or more of the centres in one class, and in no more than ten per cent of the places of a lower order. A "partial complement" indicates an activity appearing in fifty to seventy-four per cent of the members of a central place set, and in no more than ten per cent of the centres of a lower order. Thus no activity is considered characteristic of a central place group unless it occurs in less than ten per cent of the centres in a lower class.

(b). An Outline of Characteristic Functions

The grouping of activities which follows from this procedure is summarized in Table 3. In the A, or functionally least complex, class of central places there is no service or attribute that is exclusively characteristic of this order. However, this primary service centre does have a full complement of food stores, and a partial complement of second-class post offices, automobile service stations and grain milling. Class A centres are assigned these activities on the assumption that no lower order exists which could

contain places ten per cent of which serve similar functions to A centres.

The next higher order of B class places shares four central service functions in common with A centres which are not defined as typical of either set. Two non-central functions fall into this category--railway stations and telephone exchanges. The B-ranked centres have a full complement of twelve activities. The partial complement for this class includes seven functions and two non-central activities. One attribute is exclusively characteristic of these central places; seventy-five per cent are incorporated villages.

Ten services are shared by both B and C centres and are representative of neither order. The C central places have a partial complement of only three activities. Some central service functions are not characteristic of the C level because they do not appear in fifty per cent of these centres; accountant, music shop, sewing centre, business college are possibly representative of a yet higher order. There are seven functions for which C centres have a full complement and six activities are exclusive to these central places.

In summary, seven of the sixty activities or 12% are exclusive to certain orders, six of these to the C class centre. Of the remaining activities twenty or 33% occur as

a full complement in the three central place groups, and fifteen or 25% as a partial complement. Therefore forty-two of the sixty activities or 70% appear to be in some way characteristic of distinct central place orders. Ten additional activities not strongly characteristic of either C or B centres (Table 3) do not frequently occur in A places and may be thought of as characteristic of the two higher orders.

3. Functional Characteristics of the Ordered Central Places

From the preceding discussion and Table 4 it is possible to describe service, population and other characteristics of the grades of central places recognized for Perth and Huron counties.

(a). Class A Centres and Auxiliary Places

The A order place is the primary service centre averaging only four activities. Only the food store, which is invariably a general store, is common to seventy-five per cent of these places. The functions of A places are those which a dispersed agricultural population demands most frequently--food and communication. Immediate convenience buying dictates that A places must be close to their customers, therefore numerous. Table 4 indicates they are eight to twelve times more plentiful than the members of the two higher orders. Both the number of

activities and local population need not be large to provide the economic threshold necessary to support these service agglomerations.

Within the context of his central place theory Christaller introduces another order called auxiliary places which "have no central importance".[1] These places supply goods with a small local range; Christaller cites food and home wares as characteristic commodities. Despite their lack of central place status, auxiliary places fit into the theoretical spatial scheme as wreaths of six centres surrounding every full central place.

An attempt was made to isolate, on some meaningful basis, the auxiliary places from among the A class centres. The initial step in this direction was the exclusion of isolated motels, service stations and cafés mentioned earlier.

Three possible sub-groups seem most obvious among the class A places:

1) The twenty-five centres with only one central service function, the food store;

2) The forty-nine centres with single and double activities;

3) The sixty-eight places with four or fewer activities.

The centres in the third group have populations under one hundred people, approximately the median for the A order. Some double activity places possess functions characteristic

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[1]Baskin, op. cit., p. 17.

of higher ranking centres; centres with three and four activities do not add any new types of activities above those also offered by some places with one and two activities.

A tentative grouping according to the three divisions suggested was studied to determine criteria which could effectively allocate places to each of these sub-groups.

The designation of the single-activity centres as auxiliary places could be achieved if one could show that these differ from the centres with two activities. A study of the twenty-four places with two activities indicates no exclusive or full complement of activities. The most frequently-occurring services, other than the food store, are the service station and the second-class post office which appear in just one-half and one-quarter of the centres respectively. Thus the double activity centre does not differ from the single activity place in the sense that the former possesses one or more functions characteristic of its group.

When the single and double-activity centres are considered together as a possible sub-group, one finds that this division lacks exclusive, full and partial complements of any activities other than the food store. Moreover centres with three and four activities do not differ from the former sub-group in either population or new types of functions.

If one considers the sixty-eight places with four or fewer activities as a distinctive group, no activity other than the food store is found to characterize even one-half of the centres. Generally places with more than four activities have local populations exceeding one hundred. However no activities are exclusively or fully characteristic of the remaining thirty A centres. Three functions just manage to reach a level sufficient to be considered as partial complements.

Among the A class centres there appear to be no clear functional "steps" to warrant a subdivision of this group. However the possibility of auxiliary places will be re-examined in the next chapter to see whether a sub-group of A centres is more consistent with the numerical and spatial tenets of central place theory.

(b). B Class Centres

Centres of the B group average seven times the number of activities of the typical A place. This great difference in the number of services offered is one of the most distinctive differentiating features between the two orders. In population, ten of the twelve B members have more than 450 inhabitants, the outside population limit of A centres.

In addition to a full complement of the services possessed by the lower A class, this higher order includes eleven other characteristic central service functions. The

most representative members of this group of services are drug stores, physicians, automobile dealers and funeral homes which appear in none, one, two and three A places respectively.

Whereas the goods and services provided by the lowest order cater to a convenience buying market, B centre establishments are distinguished by the beginning of personal and professional services--insurance agents, hairdressers, funeral homes, physicians. Three more activities of this type (veterinary, nursing home, law firm) form a partial complement of central service functions in the B group.

Some differentiation between B and A centres is reflected in the location of branch banks. Although the incidence of banks is shared by both orders, eleven of the twelve B group banks are main offices, while ten of the fifteen banks in A places are branches of banks in higher order centres. This tendency to subordinate activities in the A places is shown to a lesser degree in types of post offices. Eleven of the twelve B centres provide all post office facilities; only nine of the forty-four A place offices have comparable facilities. In somewhat similar fashion the C centres contain only the main offices of law firms; three of the six B group law firms are branches of these offices.

Rows four and five of Table 4 show similarities between B and A centres in per capita services and

functional unit ratios; in both cases the values are almost identical. The two statistics are quite different for centres in the C class.

(c). C Class Centres

Centres of the C order are distinguished from members of the B group to a greater extent than the latter is from A centres. Population levels are quite discrete--all B centres having at least a thousand fewer inhabitants than the smallest C member. The activity/population ratio for C centres is twice that for B and A centres, a condition which is almost duplicated in the central service function/functional unit ratio. An explanation of these features and the relationship between them follows from an examination of the types of activities characteristic of the C places.

The shopper's goods stores which trade in personal adornment, i.e. jewellery and clothing, seem to form the transition between central service functions in the two higher orders, for six of the ten functions shared by the two orders are in this category. The C centres are not identified by either the well-standardized and frequently-demanded convenience goods and services, or the shopper's goods outlets which satisfy the consumer's desire to compare values, prices and styles. The characteristic activities are those of a highly specialized nature, be they of retail

trade--florists, gift shops, book stores, automobile supplies, department store order offices, photographers; entertainment--movie theatres; finance--loan companies; or medical services--optometrists, chiropractors, hospitals. It is the specialized nature of these goods and services which reflect some of the differences between C, B and A centres in Table 4.

(d). Functions, Functional Units, and Local Population in the Ordered Central Places

Since local population, the activity/population value and the central service function/functional unit ratio for C central places are distinct from comparable figures for B and A centres, a statistical test of the degree of association between population, functions and functional units was employed.

Central places were ranked according to number of functions, number of functional units and 1961 population. When tied scores occur each of them is assigned the average of the ranks which would have been alloted had no ties occurred. This ranked data appears in Appendix III to this study.

Columns (3) and (5) show the values of d_1 and d_2, the difference between the ranks (1) and (2), (1) and (4) respectively. For any two sets of ranked scores Spearman's coefficient of rank correlation may be determined by the

formula: $$r_s = 1 - \frac{6(\mathcal{E}d^2)}{n^3 - n}$$

where $\mathcal{E}d^2$ is the sum of the squares of the differences between two ranks, and n is the number of observations, in this case sixty.

When the respective values for d^2 are substituted in the formula, the coefficient of rank correlation between population size and functions is found to be 0.91, and between population and functional units 0.93. Since perfect association between two ranks is unity, a strong positive association exists between population and both the types of functions and the number of functional units, the latter relationship being closer than the former. The absolute value of these associations may be slightly high because the sixty centres were not chosen randomly, but the test is employed to determine the relative function and functional unit relations.

These findings add some strength to the opinion that the quantity of functional units is a reflection of the number of people served in the urban centre, but not necessarily in the umland. An investigation of rows 2, 3 and 4 of Table 4 indicates that the larger population of B centres does not result in a number of activities proportionally greater than the number of functions in A places; the two orders have almost identical population/

activity values. However the same figure for C central places is double that of the lower orders.

The increase of activities in the B over the A centres is not reflected by an increase in the number of people living within the centre supporting each function. One may assume that the greater median value of activities in a B centre reflects patronage from a larger umland. Although the C central places undoubtedly diversify their activities on the basis of larger trade area populations, the inhabitants of these places appear to contribute to a greater degree to the support of the local activities in that they seem to have tastes different from residents of smaller places.

Like the activity/population ratio of row 4, the service/functional unit ratio for C centres shown in row 5 increases substantially over figures for the two lower orders. The increased local population of C places contributes more to the duplication than the diversity of each kind of service.

One explanation for this multiplicity of functional units distinctive of C centres is the greater shopping opportunities which larger places offer. The incentive provided by their entertainment and shopping facilities has a tendency to encourage weekly multipurpose trips not only for specialty and shopper's goods, but also for the

convenience items usually obtained from lower order communities nearer the consumer. An elaboration of the nature and effect of local population on the variety and ubiquity of functions is presented next in the consideration of Stratford's activities.

(e). Stratford

Because of Stratford's manufacturing, entertainment and transportation base the services of this centre were not included in the tabulation and designation of central place functions. It is possible however to allocate this city to the hierarchy of service centres, and to comment on some of the functions which are associated with its much larger population.

In addition to providing all the sixty activities recorded in Table 2, Stratford offers the following twenty service functions:

office machines	automobile driving instruction
insurance adjusters	dancing instruction
radio station	credit bureaux
air conditioning contractors	trust companies
architects	dental laboratory
artists' supplies	janitor service
stock brokers	formal wear rentals
travel agencies	office auxiliary service
venetian blind cleaning	fur garments
locksmiths	
telephone answering service.	

The city of Stratford with a total of eighty activities and a population of 20,500 is an obvious and only member of an order in Perth and Huron counties next above the C order.

The population/service value for Stratford is 256, four times that of C centres. This four-fold increase, and the two-fold increment exhibited by the C central places, results in a diversity and duplication of functions which can be partially explained without reference to a sizeable non-local trade area. The needs of larger centres are much more complex than the demands of an agricultural community, and urban dwellers develop some tastes which are not representative of a rural umland, no matter how large.

Driving instruction is a service provided by Stratford but not by centres of any lower order. In rural areas nearly all members of a family are introduced to farm machinery at an early age. Moreover they usually learn to drive automobiles on isolated country roads well below the legal age limit and without government driving permits. Many other distinctly urban tastes are evident in the twenty activities listed above, as well as in the tally for the C group. In addition to the personal services such as dancing instruction and formal wear rental, there are many financial and commercial functions which cater almost exclusively to urban business offices. Thus many distinctive activities of Stratford result from a large local market.

4. Constant Progressions in Service and Population Medians for Central Place Orders

Three interesting mathematical relationships appear from a careful examination of the data in Table 4. From the

median activity values in row 2, it may be seen that

$$\bar{a} + k = \bar{b};\ \bar{b} + k = \bar{c};\ \bar{c} + k = s$$

where $\bar{a}$, $\bar{b}$, $\bar{c}$, are the median activities for members of the A, B and C central place orders and s is the number of activities in Stratford. The constant value, k, is approximately twenty-five activities.

An analysis of the data in row 4 of Table 4 shows

$$A(p/a): B(p/a): C(p/a): S(p/a) = 1: 1: 2: 4$$

where the (p/a) designations of A, B, C, S are the population/activity ratio values for A, B, C centres and Stratford, respectively.

Row 5 indicates the ratio of functional units to central service functions (not activities) averaged for the members of each order. Time did not permit the collection and compilation of this data for Stratford. Central service functions were chosen rather than activities because the non-central functions do not generally vary in number (functional units) from one centre to another.

The relationship between the median values in row 5 appears to be $Af: Bf: Cf = 1: 1.5: 1.5$ where f is the functional unit/central service function ratio averaged for members of A, B and C orders. Since there is one less value stated for the information in row 5 the reliability of the constant is not as stable as the two other constants cited above. For instance, the actual progression is 1: 1.5: 1.6. Therefore the subsequent value might be 1.7 and not 1.5 as is presumed in the next section on prediction of trends.

5. An Estimate of the Service and Population Features for the Highest Order of Central Places in Southwestern Ontario

Given the reliability of the constants suggested in the preceding paragraphs and assuming A, B, C centres and Stratford to be valid consecutive grades in the system of central places in Perth and Huron counties, it should be possible to deductively calculate certain features of the next highest order of central places. While none of the members of this next class is present in the study area it may be presumed that at least one would appear in the region of Southwestern Ontario, bounded by Lakes Ontario, Erie and Huron (Figure 5).

Based on the information and constants suggested from Table 4 the following service and population features would approximate those for average members of this projected order:

Number of activities	= (80 + 25)	or 105
Population/activity ratio	= (256 x 8)	or 2048
Ratio of functional units/central service	= (2.4 x 1.5 x 1.5)	or 5.4
Population	= (105 x 2048)	or 215,040

According to the 1961 census only two centres in Southwestern Ontario have populations close to the one computed above. Figure 5 indicates the location of these centres, London and Hamilton, with populations of 169,569

and 273,991 respectively.

Since an examination of the functional characteristics of these two cities is outside the scope of this study, the relevance of deducted features can be tested only by examining actual and predicted population. Presuming London and Hamilton to be the only two members of the higher order in the region, the average population of the order is (169,569 + 273,991)/2 or 221,780. This figure compares favourably with the estimated population of 215,040.

It should be pointed out that both London and Hamilton, and particularly the latter, are important manufacturing centres. This specialized role would increase their local populations above similar centres performing only a central place function.

Moreover the hierarchy suggested would have to make allowances for the following intermediate centres in South-western Ontario, i.e. centres with populations between Stratford's (20,000) and the estimated average population (200,000):

Windsor	114,367	Chatham	29,826
Kitchener	74,485	Galt	27,830
Brantford	55,201	St. Thomas	22,469
Sarnia	50,976	Waterloo	21,366
Guelph	39,838	Woodstock	20,486.

London and Hamilton are presumed to be members of an order of the hierarchy above the class of which Stratford is a member. Since no larger centres occupy the area between

Lakes Ontario, Erie and Huron the class to which they belong may be assumed to be the highest order in Southwestern Ontario.

6. The Central Place Hierarchy Related to the Transportation Network in Perth and Huron Counties

Complementary to Christaller's theoretical hierarchy of central places is the corresponding theoretical hierarchy of transportation routes. The transport pattern for the marketing principle, for example, is six major and six minor routes radiating from each of the first-order centres (Figure 2).

Although the correspondence between the theoretical and actual road distribution is discussed in the next chapter, at this point it is of interest to show to what extent the number and type of transportation facilities reflect and confirm the system of central places discussed in this chapter.

The road, rail and central place distribution is shown in Figure 11.[1] The classification of roads in Figure 11 is derived from conventional road map usage. A first-class highway is a hard-surfaced, wide road in good condition. A second-class highway is hard-surfaced and wide, but in only fair condition. A secondary paved road is narrower and in

[1]Figure 11 appears on a transparency for purposes of comparison with certain theoretical distributions in the next chapter. It may be found in the back-cover envelope.

poorer condition than the other two, but it has a hard surface. Unlike the previous two classes it is a county rather than provincial road. Gravel roads are not shown. It is assumed that the characteristics and maintenance of these roads reflect the volume of traffic using them.

A summary of the patterns shown in Figure 11 is presented in Table 5. Since categories in this table are mutually exclusive for each form of transportation, a centre at an intersection of first and second-class highways which is also on a secondary paved road is counted only in row 1, not both rows 1 and 2. Because transportation facilities often aided in establishing present central place status, abandoned rail lines are also considered in the ensuing discussion.

Of the nine places in the two higher orders, C and Stratford, all but two are at the intersections of first and second-class highways. Only two of the B centres are at similar intersections, and, in both cases (Hensall and Grand Bend), the second-class highway is not a through road. Only six of the ninety-eight A places are at the important road junctions, and, as with the two B centres, none of the latter highways are through roads. More than one-half of the A places are on gravel roads.

A more distinct differentiation between the transportation facilities of the various central place classes

is reflected in the pattern of railway junctions. The only centre at the junction of three rail lines is Stratford. All centres of the C class are served by rail and six are at the junction of two rail lines. Ten of the twelve B order places have railway stations, and one is served by two rail lines, one of which has been abandoned. Over three-quarters of the A places have no rail connection.

In Table 5 transportation category (5) is exclusively characteristic of Stratford. Rows (1) and (6) form almost a full complement of the C order transportation facilities. B centres dominate the percentage importance of central places in rows (2) and (7). Categories (4) and (8) best reflect the scarcity of good transportation facilities to C places.

7. The Validity of the Central Place Hierarchy Identified for Perth and Huron Counties

Although it has not been possible to prove that a class system of central places follows from an ordered gradation of thresholds, service functions or activities, it has been possible to indicate distinct features which are strongly characteristic of particular central place orders. To attain a high proportion of distinctively characteristic features, minimum appearances of 50% and 75% were accepted, with a maximum occurrence of 10% in centres of lower orders.

The allocation of activities to central place groups

on the basis of exclusive, full and partial complements does result in the identification of certain activity traits common to the members of specific orders. Summarizing Table 3, A class centres may be looked upon as places providing a partial convenience service for the local population. B centres offer full convenience and partial shopping services. C places offer exclusive complements of local administrative offices and both full and partial activities of a specialty goods and services nature. Stratford features specialty and specialized activities not characteristic of any of the lower orders.

Although the presence of a railway station enters into the calculation of central place status, the type and number of transportation facilities is a variable largely independent of the procedure for identifying orders of central places. The discussion of transportation facilities arising from Table 5 seems to confirm the distinct character of the different orders.

The feature of central places which correlates best with activity rank is population size. This is reflected in the most exclusively representative attribute, legal incorporation. The median B-class population of 784 corresponds closely to the Ontario census definition of a village, a place with 750 people within 500 acres. None of the B centres approach the legal minimum population

level of 2000 for towns, nor do the C centres approximate the 15,000 minimum population designated for cities. The A places may be regarded as exclusively unincorporated.

Consequently in the presentations which follow there are assumed to be representatives of at least four orders of central places in Perth and Huron counties corresponding to four commonly-used census terms--hamlet (A place), village (B centre), town (C centre) and city (Stratford).

TABLE 3 -- FUNCTIONAL AND CENTRAL PLACE CLASSES

	EXCLUSIVE	FULL COMPLEMENT	PARTIAL COMPLEMENT
CLASS A		Food store	Post office II Automobile Service Station Feed/seed/grain mill
Activities not strongly characteristic of either B or A	Hardware Bank Farm equipment		Restaurant Railway station Telephone exchange
CLASS B	Incorporated village	Post office I Insurance agent Builder's supply Hairdresser Cold storage Hotel Auto. dealer Bakery Funeral home Physician Furniture store Drug store	Library Weekly newspaper Veterinary Bowling/billiards Variety store Nursing home Law firm Dairy processing Truck transport
Activities not strongly characteristic of either C or B	Men's apparel Jewellery Family apparel Government liquor store	High school Department store Women's apparel Public utilities office	Dentist Shoe store
CLASS C	Incorporated town Hospital Retail Auto. supplies Dept. store order office Photographer Government offices	Florist Gift shop Optometrist Soft Furnishings Children's apparel Taxi service Chiropractor	Finance company Theatre Book shop
Activities not strongly characteristic of C	Accountant Music shop		Sewing centre Business college

TABLE 4

SERVICE AND POPULATION FEATURES
OF ORDERED CENTRAL PLACES

	A	B	C	Stratford
(1) Number of Centres in Each Order	98	12	8	1
(2) Number of Activities				
Range	1 - 15	20 - 38	46 - 60	80
Median[a]	4	28	54	
(3) Population	(40 places)			
Range	50-433	418-1232	2247-6411	20,500
Median	109	784	3269	
(4) Population/ Activity Ratio	27	28	61	256
(5) Ratio of Functional Units/ Central Service Functions				
Range	0.8-2.0	1.1-3.2	2.1-3.5	
Median	1.0	1.5	2.4	

[a] The median provides a better basis of comparison than the mean, because as a measure of central tendency, it is unaffected by extreme values.

TABLE 5

A SUMMARY OF TRANSPORTATION FACILITIES
IN MEMBERS OF CENTRAL PLACE ORDERS

Transportation Facilities	Number of Centres (As a Percentage of the Total Number in the Order)			
	A	B	C	Stratford
(1) At the intersection of 1st or 2nd class highways	6	17	75	100
(2) At the intersection of 1st or 2nd class and secondary paved roads, or at the intersection of two secondary paved roads	15	75	25	
(3) On one paved road	24	8		
(4) On unpaved roads	55			
(5) At the junction of three rail lines	. .	. .	. .	100
(6) At the junction of two rail lines	. .	8	63	
(7) On one rail line	21	85	37	
(8) No rail connection	79	15		

CHAPTER IV

THEORETICAL AND EMPIRICAL AREAL PATTERNS OF CENTRAL PLACES IN PERTH AND HURON COUNTIES

The spatial implications of central place theory were presented in section 2(d) of the introductory chapter. The present portion of this study describes the degree of agreement between theoretical patterns and observed findings. The next chapter discusses the historical distortions which Christaller claims work to disturb ideal spatial relationships.

1. Theoretical Central Place Distances and Numbers Based on the Actual Number of Central Places in Each Order

Given the number of central places in an order it is possible to arrive at a theoretical distance between these centres when they are evenly-spaced in a uniform hexagonal system. The formula used is that suggested by Barnes and Robinson.[1] The ideal distance between equidistant centres of the same order is computed from $D = 1.07\sqrt{A/n}$ where A is the study area in square miles, n the number of places, and 1.07 a constant factor derived from the area of a hexagon.

In the last chapter a system of central places in Perth and Huron counties was presented consisting of one city, eight towns, twelve villages and ninety-eight hamlets.

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[1] J.A. Barnes and A.H. Robinson, "A New Method for the Representation of Dispersed Rural Population," Geographical Review, XXX (1940), p. 135.

A sub-group of auxiliary places for the latter order was suggested but at that point no valid basis was found for identifying such a group.

Using the above formula, the ninety-eight hamlets in the study area would be 5.0 miles apart if spaced uniformly in a hexagonal network. The twelve villages, eight towns and one city would be theoretically 14.2 miles, 17.4 miles and 49.4 miles apart respectively.

The actual distances between members of each order are shown in Figure 12. The frequency with which distances occur is shown rather than simply the range and median in order to indicate if there are certain distances which deviate from the recorded medians. Such is the case for distances between towns. Only two measured distances fall in the same category as the median town distance of nineteen miles. The most common distance interval between towns is twenty-two to twenty-four miles.

On the other hand, the median hamlet and village distances do appear in the most frequently occurring distance category for their respective orders. The observed city distances shown are those between Stratford and its nearest surrounding neighbours of equal or larger population size.

The measured distances are smaller than the theoretical distances cited above for all but the town order. Thus the central place distances in Perth and Huron do not correspond closely to an ideal hexagonal distribution within the boundaries of these counties.

Having established theoretical distances based on the number of central places, it is possible to calculate the central place numbers and distances which result from Christaller's three spatial principles. According to Christaller's market principle or the rule of threes, the number of central places increases by a multiple of three for succeeding higher orders, and the distance between members of each higher order increases by $\sqrt{3}$. Corresponding constants for the traffic and separation principles are 4 and $\sqrt{4}$, and 7 and $\sqrt{7}$ respectively.

Theoretical distributions according to the rule of threes, fours and sevens based on central place numbers are indicated in Table 6. The pattern based on ninety-eight hamlets approaches measured central place distances and numbers only for towns according to the traffic principle and villages according to the separation principle. The calculations derived from twelve villages do not reflect any actual figures for Perth and Huron. A system based on eight towns leads to a close correspondence of distances for cities and hamlets according to the rule of fours. The town distance and number for the rule of sevens and the village distance for the rule of fours best reflects reality in the pattern deriving from one city in an hexagonal trade area.

2. Theoretical Central Place Distances and Numbers Based on Median Measured Distances for Each Order

Using median measured distance rather than number of centres for each order, sets of theoretical data may be compiled in the same manner as in the previous section. This information is presented in Table 7.

Theoretical results from the median hamlet distance yield figures comparable to actual distances for towns and cities according to the traffic principle. Numbers of centres relate rather closely to towns and villages according to the rule of fours and sevens respectively.

The number of villages (14) calculated from the median village distance corresponds well with the actual number of villages in Perth and Huron (12). When derived from village distances, hamlet distance and number according to the rule of sevens reflect measured values.

The median town distance of nineteen miles results in a number of centres (7) very close to the number of towns in the study area (8). The city distance according to the marketing principle and the hamlet distance and number from the traffic principle are fairly consistent with actual figures.

For cities 32.5 miles apart, town and hamlet distances according to the rule of threes and fours respectively, and town numbers according to these same principles are quite representative of the actual central place distribution.

3. A Review of Theoretical Distance-Number Relationships

In reviewing the information shown in Tables 6 and 7, the most that may be claimed for the relationships shown is that they indicate broad guidelines for further investigation. Very few of the number-distance values are precise. This may be expected since a small change in either the number or distance used as the basis for calculation yields quite different results when expanded exponentially according to a rule of threes, fours or sevens.

The Christaller spatial principle which yields distance and number results most consistent with expirical values is the traffic or transportation principle. Generally the marketing multipliers (3 and 1.73) and the sociopolitical multipliers (7 and 2.62) result in number-distance progressions too small and too large respectively when based on measured values in Table 6 and 7. Among the different calculations of class distance and number, the measured town and village distances result in town and village numbers closely approximating actual numbers of centres in these two orders.

Since the above mathematical computations do not reflect precise conformity with theoretical distributions, a diagrammatic approach is used to allow a graphic analysis of the hierarchy in Perth and Huron counties.

4. A Theoretical Grid Pattern of Central Places

A schematic system of central places in a grid rather than hexagonal pattern can be drawn using actual town and village locations and distances in Perth and Huron. As mentioned in the preceding paragraphs the theoretical features of these orders come closest to matching the actual situation in the study area. The theoretical lattice for the four orders represented in Perth and Huron is shown in Figure 13.

A number of observations lead to the postulation of this type of network. The succession of central places on main highways of town-hamlet-village-hamlet-town corresponds to the general distribution along Highways 4 and 86 (Figure 11). Trade areas of central places in Perth and Huron are more often square or rectangular than circular or hexagonal (Figure 14), and as such would be distributed according to a system other than that of regular hexagons.

To test whether a grid system of central places is a better-fitting arrangement in Perth and Huron than a pattern of regular hexagons, the study area was assumed to be a square forty-six by forty-six miles. The theoretical distance apart of equidistantly spaced square service areas for each order is calculated from $D = \sqrt{A/n}$, i.e. the same formula used previously without the constant derived from the area of a hexagon.

For a hexagonal system the hamlet, village, town and city theoretical distances are

5.0, 14.2, 17.4, and 49.4 miles;

for a grid pattern comparable values are

4.7, 13.3, 16.3, and 46.2 miles.

Again, the actual median distances are

4.0, 13.0, 19.0, and 32.5 miles.

For the hamlet, village and city orders the formula for square trade areas gives a closer correspondence to real distances than the formula for hexagonal spheres of influence. Thus the distribution of central places in Perth and Huron appears to suit a geometrical system which does not demand a hexagonal arrangement of tributary areas.

5. Characteristics of the Grid Central Place System

(a). Central Place Distances and Numbers

From Figure 13 the number of central places in each order may be counted and the distance apart of members of the order measured. Fifty-eight hamlets, fifteen to seventeen villages,[1] six towns and two cities are considered to lie within the area. These numbers reflect Christaller's rule of threes, the market principle. However distances increase according to the traffic principle--5.8, 11.5, 23 and 46

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[1]Two villages lie outside the county boundaries but are very close to the villages of Tavistock and Palmerston. The latter centre is indicated on Fig. 11 with a partial village symbol. It has been allocated to this order according to its population size, 1554.

miles for hamlet, village, town and city distances respectively.

(b). Auxiliary Places

According to a grid system based on the location of villages and towns, approximately sixty, and not ninety-eight, hamlets should appear in the study area. This large discrepancy between expected and observed numbers again raises the question of auxiliary places among the A order centres.

In the last chapter central places below five, three and two activities were suggested as possible auxiliary places. Eliminating centres with four or fewer activities, two or fewer activities, and one activity would leave 30, 49 and 73 hamlets respectively. Either of the latter two could approximate the theoretical number of hamlets in the grid arrangement of central places.

The distance between hamlets and the higher order centres provides a possible clue to the number of places worthy of hamlet status. In both the hexagonal and grid distributions, theory dictates that the distance between members of an order is identical to the distance between these centres and members of a higher order.

Figure 15 indicates measured distances to centres of higher orders in Perth and Huron. The median distances between villages and towns corresponds fairly well with

measured distances between members of the village order. However hamlet to village, and hamlet to town and city distances are higher than hamlet to hamlet ranges, indicating these higher values may be more indicative of the spacing of "true" hamlets. Unfortunately there are two sets of distances--5.0 miles and approximately 6.3 miles, representing hamlet to village and hamlet to town and city measurements respectively.

When A centres with one activity are eliminated and distances between remaining places measured the average result is 5.0 miles. When A centres with one and two activities are eliminated and distances between remaining places measured the average result is 6.3 miles. Consequently the hamlets remaining when either suggested sub-group is disregarded can correspond to actual median distances in Perth and Huron counties.

Other than pointing to a grouping of single-activity or single and double-activity centres, a spatial analysis of central places does not resolve the issue of which of these divisions may be regarded as Christaller's auxiliary places. Therefore for want of a clearly defined alternative, the original premise is retained--even the smallest retail distributor is assumed to draw a certain amount of business from a local tributary area and may be regarded as a central place.[1]

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[1]Isolated service stations, cafés and motels on major highways excepted.

(c). A Comparison of the Grid with the Actual Pattern of Central Places in Perth and Huron

The arrangement of central places in Figure 13 represents the best fit according to the grid pattern. If the number of centres is increased to approach more closely the actual number of centres, then distances would decrease and the towns and villages north of Highway 8 would not lie on main roads. In fact, it is in the hierarchy of theoretical transportation routes that the schematic grid most matches the situation in Perth and Huron counties--compare the road classifications and locations in Figures 11 and 13.

However in two respects the grid system falls short of an ideal graphic representation of central places in the study area. In Figure 13 the city locations have been superimposed on the grid in order to accommodate the status of Stratford. Theoretically cities should be situated as far from towns as the towns are from themselves, i.e. 23 miles. This would place the two cities sixty-nine miles apart, in which case no central place of this importance would appear on the grid.

In addition a square lattice is imperfect in reflecting the distribution in Perth and Huron because it results in a regular distribution with equal distances in all directions between like centres. Figure 11 indicates that towns, for example, are closer in an east-west direction than they are in a north-south direction. For most villages and hamlets

the opposite is the case. Consequently any geometrical schemata utilizing trade areas with regular shapes cannot fully accommodate the actual pattern of central places in Perth and Huron counties.

6. The Distribution of Central Places According to Christaller's Traffic Principle

As stated earlier in this chapter, the spatial principle which yields theoretical distance and number values most consistent with empirical results is the transportation principle. This is the Christaller theorem which best fits the grid pattern in terms of distances and number of centres. In addition the traffic rule is more flexible in adapting to reality by allowing different distances between members of the same order.

> The complementary regions of central places . . . do not have the most rational hexagon form, but rather are very irregular in form. On the main line, they have little depth but greater extension to the side; away from the main line, they are more consistent and larger. One sees immediately that if the central places are distributed according to the traffic principle, a considerably higher number of central places of each type will be necessary in order to supply the region with central goods of a particular range. This contrasts with the marketing principle, which economizes on the number of central places required to supply the whole land.[1]

The extension of central place trade areas perpendicular to the major traffic routes may be seen in Figure 14.

The theoretical spacing of central places according

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[1]Baskin, op.cit., p. 76.

to the regular hexagonal tributary areas of the market principle is illustrated for Perth and Huron in Figure 16. As Christaller points out fewer central places would supply the study area under the rule of threes; in Figure 16 one city, three towns, nine villages and thirty hamlets appear within the county borders.

Villages do not occur between towns on major routes in Figure 16 as they do in the grid and traffic theoretical patterns, and as they actually do in Perth and Huron (Figures 13 and 11). Christaller refers to the marketing principle as having a "between-directions" orientation of central places as opposed to the "on-direction" arrangement of centres when the traffic principle prevails.

A graphic representation of the distribution of central places according to the sociopolitical or separation principle is not shown since the number of villages and hamlets which follow from the number of towns would far exceed the observed distribution (see Table 7, section 3). Like the marketing principle the rule of sevens is based on a regular honeycomb arrangement of complementary areas.

The irregularity of the transportation principle distribution is shown in Figure 17. The distances on routes parallel to Highway 8 (roughly east-west) are shorter than those in a north-south direction. The hamlet, village, town, city distances in the former case are

5.6, 11.3, 22.6, and 45.2 miles respectively,

and for the latter situation

6.3, 12.6, 25.2, and 50.4 miles. In combination these distances correspond well with frequent class distances found in Perth and Huron, particularly 12.6 miles for villages and 22.6 miles for towns (Figure 12).

While distances approach actual values slightly more closely in the traffic pattern than they do in the grid system, the number of centres in each order vary in their correspondence with the hierarchy in Perth and Huron counties. Theoretically the grid pattern would not show either of the two cities shown in Figure 17. In contrast, fewer towns appear according to the traffic principle--four may be counted in Figure 17, six in Figure 13. Village and hamlet numbers are almost identical to those resulting from a grid distribution.

Having suggested and examined a hierarchy of central places for Perth and Huron counties, and having suggested and examined theoretical spatial patterns which might best fit this distribution, one can proceed to investigate the factors which contribute to or detract from a close relationship between theoretical and observed central place distributions.

> Thus, the theory which has been presented up to this point is imperfect in three respects. We can almost say that it is basically incorrect and therefore requires correction. First, the simple fact of variability and the further fact that every factor.

> has varied must be considered, i.e., the time element must be incorporated in an abstract form.. . . Second, the actual concrete time of the passage of history with its determinations and realities is to be considered inaccessible and incalculable with respect to the theory. Third, in reality that part of the earth's surface used to illustrate concrete space is the result of special geographical conditions. Only after considering these three points will we have a complete picture of the actual relations.[1]

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[1] Ibid., p. 72.

Fig. 12 Distances to surrounding centres of the same order

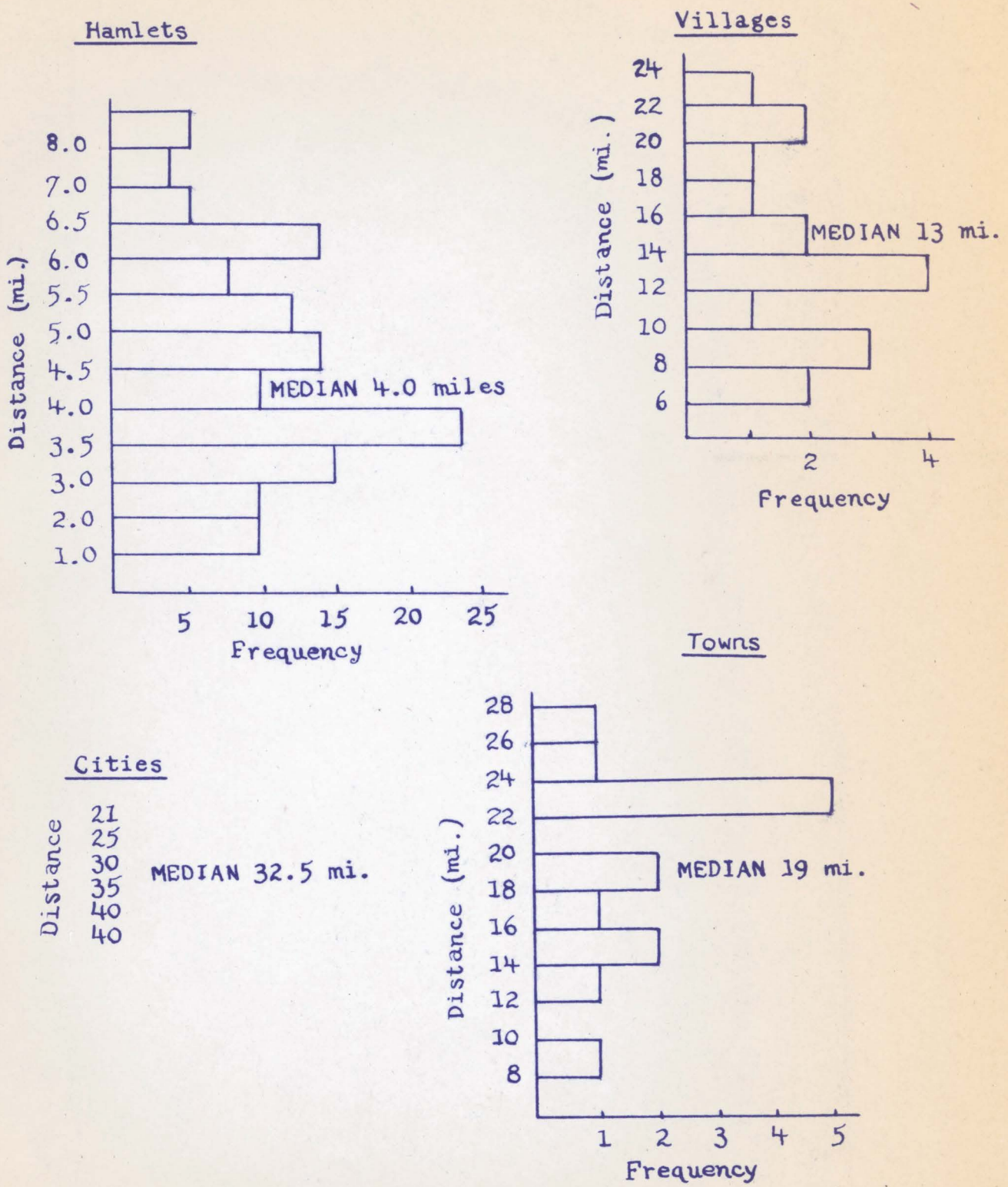


TABLE 6

THEORETICAL CENTRAL PLACE DISTANCES AND NUMBERS BASED ON ACTUAL CENTRAL PLACE NUMBERS

Central Places	Market Principle		Traffic Principle		Separation Principle	
	Distance (in miles)	No.	Distance (in miles)	No.	Distance (in miles)	No.
(1) For 98 Hamlets						
Hamlets	5.0	98	5.0	98	5.0	98
Villages	8.7	33	10.0	25	13.1	14
Towns	15.1	11	20.0	6	34.3	2
Cities	26.1	3	40.0	1	89.9	0
(2) For 12 Villages						
Hamlets	8.2	36	7.1	48	5.4	84
Villages	14.2	12	14.2	12	14.2	12
Towns	24.6	4	28.4	3	37.2	2
Cities	42.6	1	56.8	1	97.5	0
(3) For 8 Towns						
Hamlets	5.8	72	4.4	128	2.5	392
Villages	10.1	24	8.7	32	6.6	56
Towns	17.4	8	17.4	8	17.4	8
Cities	30.1	3	34.8	2	45.6	1
(4) For 1 City						
Hamlets	9.5	27	6.2	64	2.7	343
Villages	16.5	9	12.4	16	7.2	49
Towns	28.6	3	24.7	4	18.9	7
Cities	49.4	1	49.4	1	49.4	1

TABLE 7

THEORETICAL CENTRAL PLACE DISTANCES AND NUMBERS BASED ON MEDIAN MEASURED DISTANCES

Central Places	Market Principle		Traffic Principle		Separation Principle	
	Distance (in miles)	No.	Distance (in miles)	No.	Distance (in miles)	No.
(1) For Hamlets which are 4.0 miles apart						
Hamlets	4.0	154	4.0	154	4.0	154
Villages	6.9	51	8.0	39	10.6	12
Towns	12.1	17	16.0	10	28.0	2
Cities	20.9	5	32.0	3	74.2	0
(2) For Villages which are 13.0 miles apart						
Hamlets	7.5	42	6.5	56	4.9	98
Villages	13.0	14	13.0	14	13.0	14
Towns	22.5	5	26.0	4	34.5	2
Cities	38.9	2	52.0	1	91.0	0
(3) For Towns which are 19.0 miles apart						
Hamlets	6.3	63	4.8	112	2.7	343
Villages	11.0	21	9.5	28	7.2	49
Towns	19.0	7	19.0	7	19.0	7
Cities	32.9	2	28.0	2	50.4	1
(4) For Cities which are 32.5 miles apart						
Hamlets	6.3	54	4.1	128	1.8	686
Villages	10.8	18	8.2	32	4.6	98
Towns	18.8	6	16.3	8	12.4	14
Cities	32.5	2	32.5	2	32.5	2

Fig. 13 A grid pattern of theoretical central places

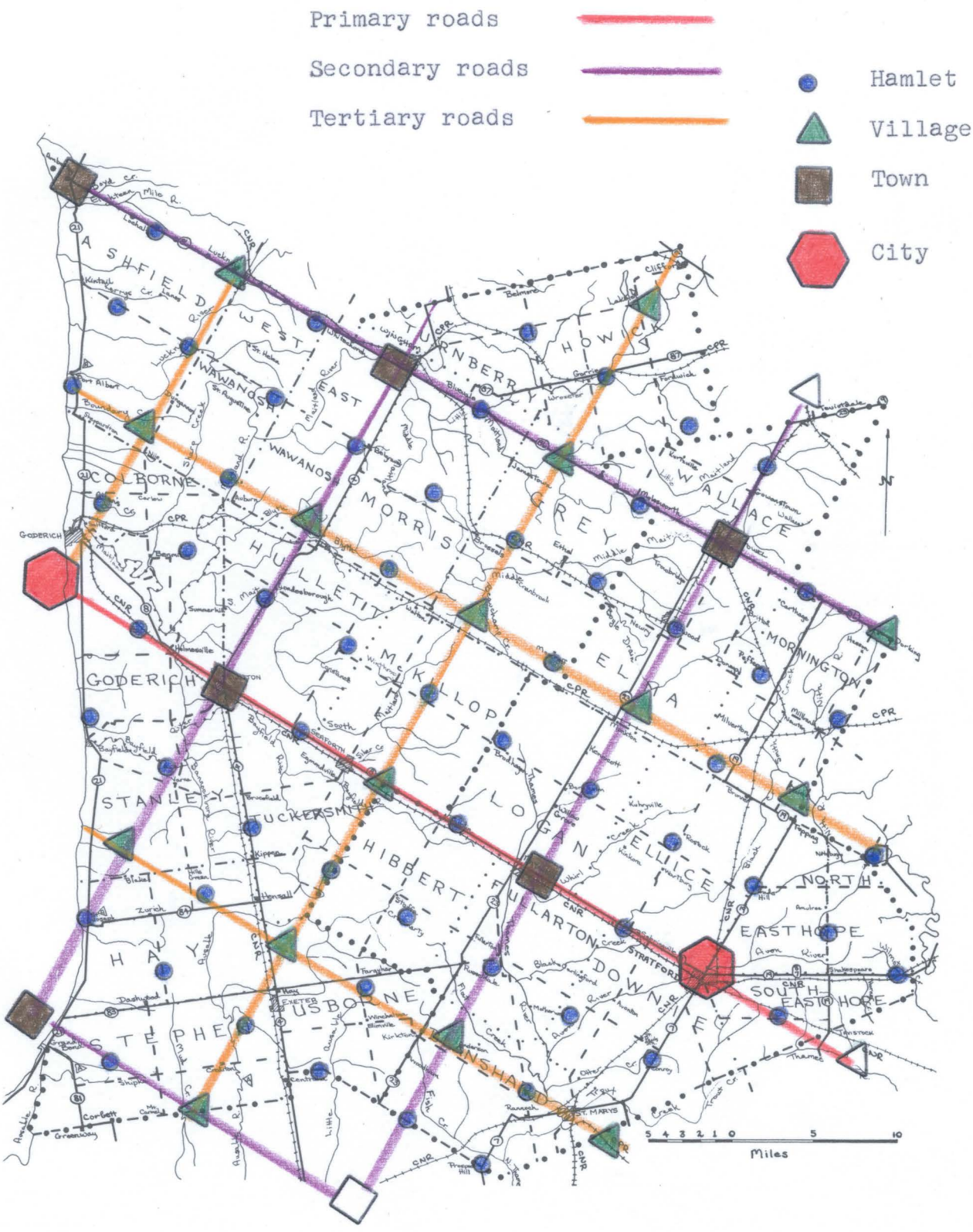


Fig. 14 A sample of bank trade areas

Fig. 15. Distances to centres of a higher order

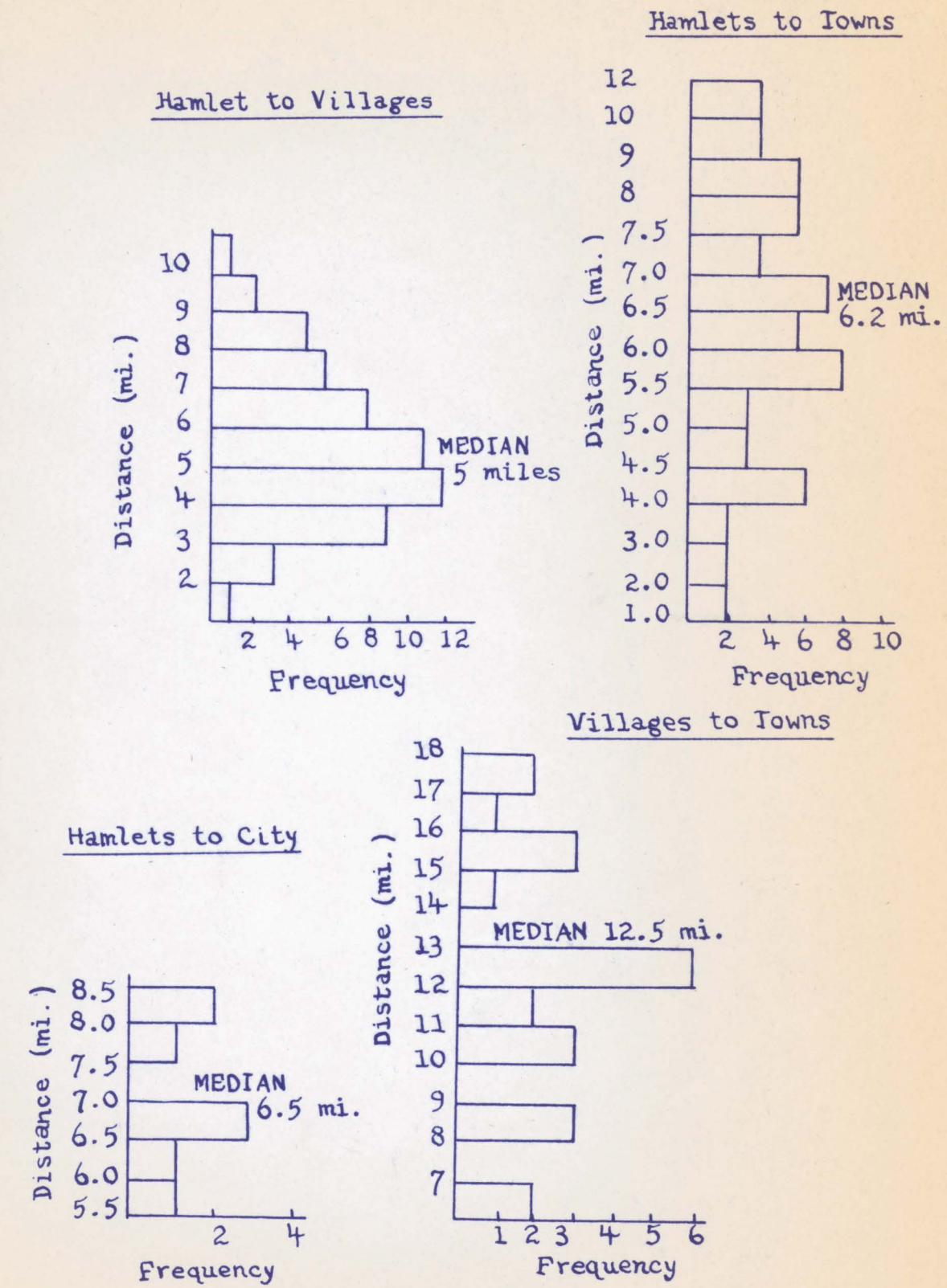


Fig. 16 Central place distribution according to the marketing principle

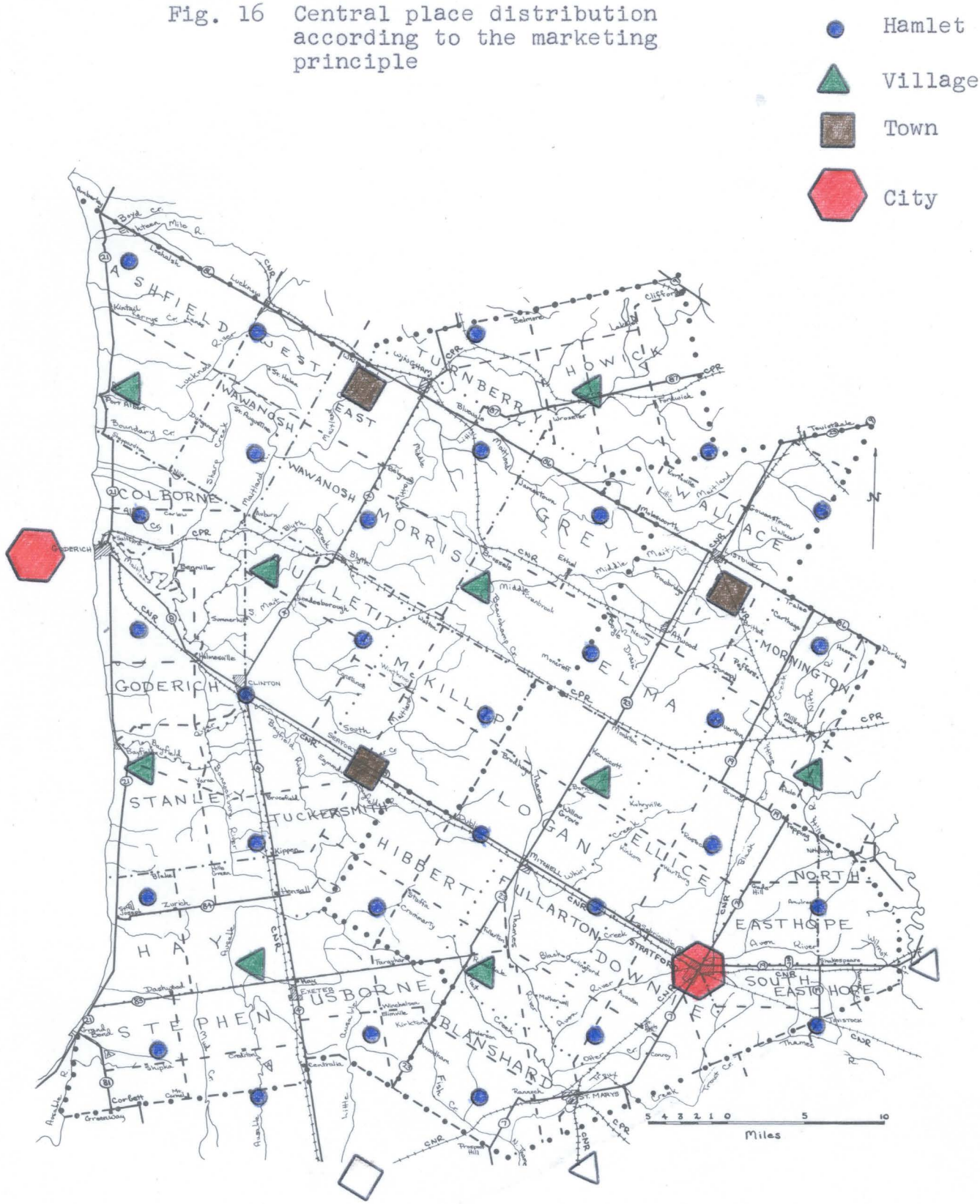
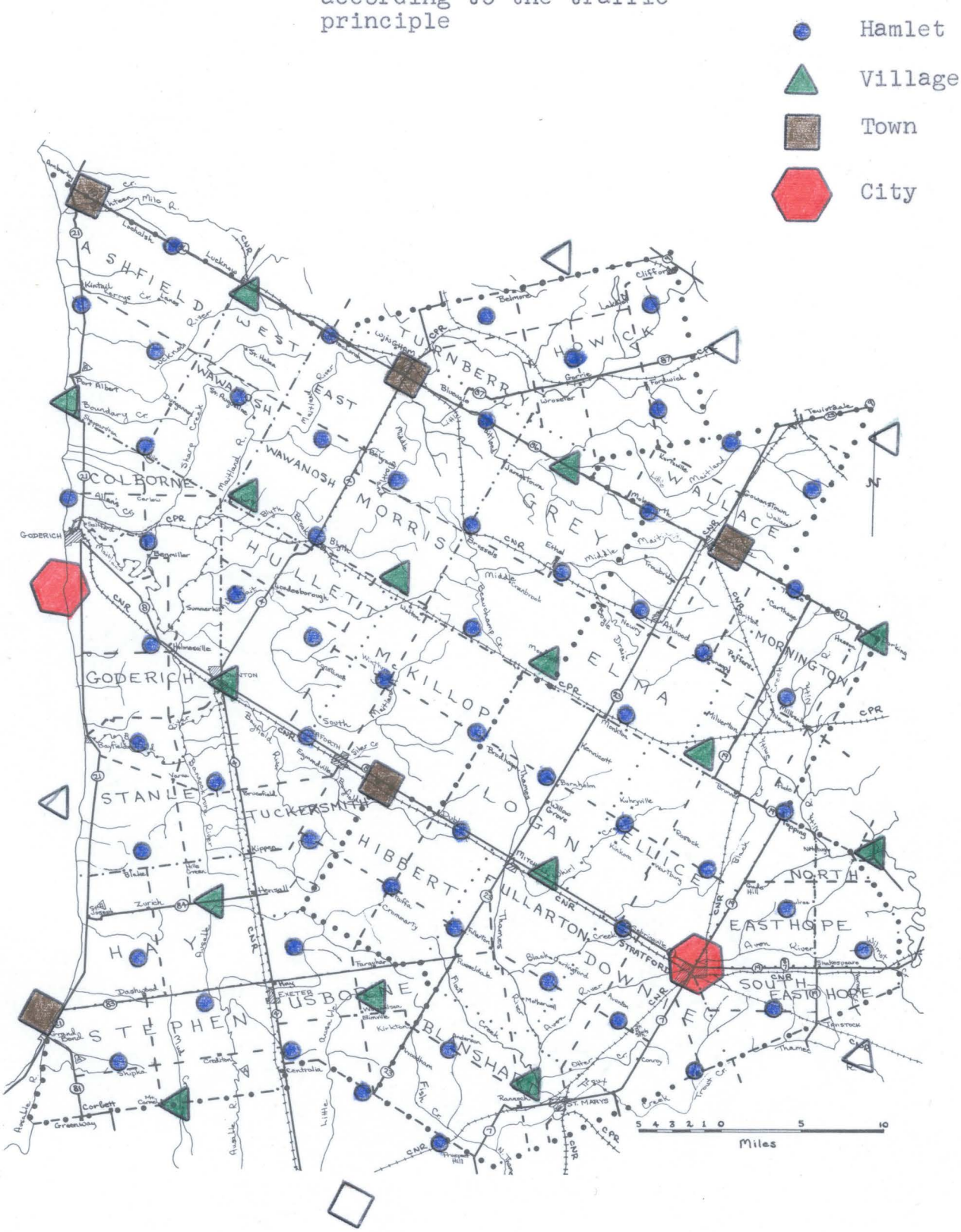


Fig. 17 Central place distribution according to the traffic principle



CHAPTER V

MAJOR HISTORICAL-GEOGRAPHICAL FACTORS AFFECTING CENTRAL PLACE LOCATION IN PERTH AND HURON COUNTIES

> Deviations from the rational pattern of central places not explainable by economics will be only enumerated here, for they are not a direct subject of the present inquiry. These deviations are primarily those which can be explained by completely different causes, which we group together as historical. Here belong places founded by sovereign nobility; . . . places founded by immigrants or religious sects; . . . or industrial towns, which owe their prosperity to the spirit of enterprise of an individual. . . .
>
> Physiographical deviations occur mainly in small areas: The theoretical point for a central place is only a general estimate. Which locality in particular- that is, which topographical position- is actually chosen . . . is dependent both on the usual valuation of the position at the time of founding of the town, . . . and on the geographical existence of such a preferred location.[1]

Christaller confines his investigations almost exclusively to what he considers to be the economic factors which can cause distortions from ideal spatial patterns: price differences, density and distribution of population, industrial location, changes in technology, seasonal and cyclic economic variations, land prices and income levels.

> Purely geographical factors, such as topography, cultivation of the soil, flora, and the climate, which cause deviations from the scheme, are disregarded in our consideration, as are purely historical, political, ethnic, and personal factors.[2]

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[1] Baskin, op. cit., p. 195,

[2] Ibid., p. 112.

The economic influences discussed by Christaller are considered to be largely beyond the scope of this study. However some of the historical-geographical factors which he disregards are found to be of major importance in the development of central places in Perth and Huron counties; these may be summarized into four types of determinants--historical primacy, transportation, land and site attraction and entrepreneurial policies.

The ensuing historical analysis is intended to indicate the effects of these factors on the present spatial patterns in the study area. The final section of this chapter is intended as a synthesis of the extent to which historical-geographical factors have influenced the theoretical central place systems outlined in the previous chapter.

1. Historical Primacy

> Locational decisions are made at a point in time, after which social and economic conditions may radically change. Established locations possess great inertia; once decided upon, removal is difficult.[1]

In order to investigate the principle of historical primacy and inertia, the service centres of Perth and Huron counties were tested for a relationship between their ages and functional classes. A direct relationship between the

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[1] R.L. Morrill, "The Development of Spatial Distributions of Towns in Sweden: an Historical-Predictive Approach," Annals of the American Association of Geographers, LIII (1963), p.2.

early establishment of a centre and a high position in the hierarchy would tend to substantiate a concept of historical primacy--initial places assume and retain greater importance.

Records are too fragmentary and unreliable to determine the exact date of founding for all centres. However, the dates at which post offices were established are available for 103 of the 119 central places in the study area. The post office was one of the first requirements in the frontier region; it was founded at an early date and usually coincided with the naming of a centre. As witnessed in Chapter III, the post office is still one of the most universal functions in central places. In pioneer times the need for communication was of such prime and ubiquitous importance that nearly all agglomerated settlements demanded and seemed to receive post office recognition. Approximately 150 places in Perth and Huron counties had post offices in the nineteenth century.

Figure 18 shows post office founding dates in the study area. Offices with similar founding dates at convenient ten-year intervals are joined by smooth lines. In this way the map serves as a tool to trace the general direction and extent of settlement. It is a superior indicator of developing settlement than census population figures which are given only on a township basis and only for ten year periods.

Table 8 indicates the relationship between post office founding dates and central place orders. Although the median dates show a fairly direct relationship between central place status and age, there is overlap between the groups due to a dichotomy of historical development in the study area. The townships fronting on, and to the north of Highway 8, and all townships to the south of this thoroughfare, formed the major portion of an area known as the Huron Tract, which was developed for sale by a private firm, the Canada Company, as early as 1827.[1] The remaining ten townships of Perth and Huron counties, the ones to the north of Colborne, Hullet, McKillop, Logan and Ellice, formed a part of the "Queen's Bush", Crown land which was opened up for development in 1854 and 1855. The boundary between these two historical regions is emphasized by the disconformity of roads and township limits along this line.

Generally, the important centres began early, and the early centres became the most important. The first places settled had the greatest opportunity of becoming regional foci during the frontier period. Due to their historical priority, they could serve as supply posts for new settlers moving into other areas, and could act as processing and transportation nodes for newly developing areas. The stage of development of service centres at certain critical times,

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[1]The boundary of the Huron Tract is shown in Fig. 19.

such as the coming of the railways, was very significant, since the railway routes depended mainly on preceding patterns of settlement.

2. Transportation Routes

(a). Early Colonizing Roads

> Normally roads appeared shortly after the first settlers. In 1827, however, the carriage-width Huron Road was blazed by the Canada Company before anyone had arrived, to ensure prospective pioneers at least primitive land communication between Lake Ontario and Lake Huron.[1]

The suggestion in the previous section is that first settlements become the most important central places. The main argument of this section is that first settlements occurred along already existing roads. Initial roads were not related to the distribution of rural population but preceded settlement, and reflected not central place distribution, but land promotion policies and the pre-existent transportation network.

The Huron Road, opened in 1827, was an extension of the existing colonial highway as far as the Avon River (Figure 19). From there it was cut directly towards the site of Goderich where a post had been established a year earlier by two fur traders from Detroit. The London Road, Highway 4, was completed in 1832. It was cut south from an inn at the present site of Clinton to connect with the

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[1]Edwin C. Guillet, The Story of Canadian Roads (Toronto: University of Toronto Press, 1966), p. 50.

London and Proof Line Road, the present Highway 4 in London township. However, the location of the London Road was not governed solely by the position of the London and Proof Line Road, for the former makes a jog to the east for six miles before it joins the latter. Starting at Clinton, and paralleling the Lake Huron shore, the London Road provided the most effective access to the maximum number of townships not already served by the Huron Road. Its function as a township boundary is evident from the area map, and is notable particularly in Hullet township. Here the western border is formed by the extension of the London Road north through Clinton, and not by the present Highway 4 from Clinton to Wingham which was constructed later.

At the intersection of two colonizing roads or extensions of these roads conditions were favourable for the emergence of an important centre. These centres could serve as stopover and supply posts for settlers moving into new areas. A comparison of the modern and early road patterns (Figures 11 and 19) indicates that important roads north of the Huron Tract in the Queen's Bush portion of Perth and Huron either followed the survey pattern of the Tract (Highway 86) or were extensions from early settlements to the south (Highways 19, 23, 4).

The triangular configuration of the Huron Tract shown in Figure 19 resulted in a funneling or focusing of

routes on Stratford, near the eastern apex of the Tract. Because of Stratford's location close to the major eastern markets in colonial Canada, much of the trade of the area passed through this centre. It was also nearest to the important routes for immigrant-settlers, and was selected by the Canada Company as the headquarters for land sale offices.

The development of some central places in Perth and Huron were a result of the placement of pioneer roads according to the planning policies of the Canada Company; many other centres owe their development, and in some cases their origin, to the coming of the railways.

(b). Railways

The railway is not nearly as vital today as it was in the nineteenth century, but its effect is significant, for as may be seen from Table 5 and Figure 11, few of the places missed by the railway survived as present villages and towns. The stimulus provided by the collecting and distribution functions associated with a long distance railway line was responsible for the growth of existing centres and the attraction of new central places to the rail line.

The present village locations were most affected by the pattern of early railway expansion. Hensall was planned in 1877 around the station along the new London, Huron and

Bruce railway. The present village of Atwood owes its origin to the fact that the railway through Elma was directed to bisect the township and consequently curved west toward Wingham just a mile north of the hamlet of Newry. Newry merchants soon moved to the new station of Atwood. The village of Blyth developed under the influence of a railway from Clinton to Wingham built in 1879 and abandoned in 1940.

The present towns, already established as central places at the beginning of the railway era, received a significant impetus in their rise from village and hamlet status. Wingham was a backwoods village until the arrival of two branches of the Great Western Railway. The building of the Buffalo and Lake Huron Railway made such a rapid increase in the populations of Clinton and Mitchell that they both became incorporated villages in 1857, the year the railway arrived. When this railway was being constructed, three neighbouring hamlets vied for a station--Egmondville, Harpurhey and Seaforth, the former two being many times the size of the latter. All three tried to influence the company to set up a station, but Seaforth merchants laid out a village plot and offered the station grounds and building to the railway firm free of charge. Its once more populous rivals soon declined as merchants moved to Seaforth.

The rise of Seaforth as a railway and service centre exemplifies the factors operative in the development of the railway network in Perth and Huron counties--the distribution of larger centres and the availability of financial incentives. The latter factor will be discussed with specific references in the section on entrepreneurial policies. These two principles are interdependent in most instances since the railways were largely financed by money from the municipalities concerned. The centres had to have a large enough population to provide the capital, business and passenger potential necessary to draw the railroad. "Cities built railways, towns and villages attracted them, and hamlets were lucky if they got them."[1] The smaller places which were tapped by railways were usually aligned between larger centres.

Since the railroads gravitated towards the larger existing centres, the network of railways coincided closely with the pattern of early roads, thereby consolidating the former distribution of central places. Two of the earliest and most important railways followed the earliest and most important roads--the Buffalo and Lake Huron Railway, 1857, along the Huron Road, and the London, Huron and Bruce, 1876, along the London Road. In 1859 the Grand Trunk was built from Guelph to Sarnia, and since it was promoted in part by

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[1]D.W. Kirk, "Southwestern Ontario: The Areal Pattern of Urban Settlements in 1850" (unpublished Ph.D. dissertation, Dept. of Geography, Northwestern University, 1949), p. 171.

the Canada Company, it was directed through the towns of Stratford and St. Marys.

The railway era in the Huron Tract came only a year after the opening of the Queen's Bush for settlement. Thus as the frontier expanded away from older centres, the railways reduced the distance factor enabling the central places in the Tract to extend their influence into newly-settled areas.

3. Land and Site Attraction

(a). Land Attraction

Since the frontier centre was almost exclusively dependent on its function as a central place, its existence and development would be closely linked with the density of the district farming population. The attractiveness of the landscape for farmer-settlers in the early period of population concentration is an important causal factor of central place distribution.

Kirk forwards the suggestion that the level plains were probably least desirable to the farmer-immigrant initially because natural drainage was not as good, underbrush was thicker and more difficult to remove, roads were sometimes impassable, and the abundance of insects promoted sicknesses such as malaria.[1] If the level plains with their attendant disadvantages retarded settlement, then morainic uplands

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[1]Kirk, op. cit.

with their corresponding advantages promoted it. These higher lands would be initially attractive because of good drainage, lighter vegetation, and numerous small power sites.

The relationship between physiography and early settlement is evident from a comparison of Figures 6 and 18. The areas showing later development of post offices are indicated by the lighter colours; these generally correspond to the till plain regions of the physiography map. The sections of late settlement that are most striking are the imperfectly-drained inter-morainic areas of Ellice and Logan, McKillop and Grey, Hibbert, Blanshard and Usborne townships (Figure 6). The other large area developed subsequent to 1860 corresponds to the marsh, sand and till plain near the mouth of the Ausable River. There are strong signs of a correlation between areas of early development and morainic uplands in Goderich, Colborne, and West and East Wawanosh townships, and along the moraines of Tuckersmith, Hibbert Usborne and North Easthope. A less marked relationship exists between the drumlinized landscape of Howick and Turnberry townships and the founding of post offices prior to 1860. With the exception of level plains adjacent to colonizing roads, it appears that early settlers tended to locate farms on the better-drained morainic uplands.

The close correspondence between physiography and the spread of pioneer settlement in the nineteenth century

is not as evident in the rural population distribution at the present time. The map showing householder distribution along rural routes, Figure 4, indicates limited areas of sparse settlement near Clinton, Bayfield and Exeter, and north of Stratford in Ellice and Elma townships. Despite the Canada Company's motto "Non Mutual Genus Solum" (One Cannot Change the Character of the Soil), the good or poor effects of the physical landscape can change profoundly with time. The marshy plains near the mouth of the Ausable River, which were initially considered useless for farming, have been drained and become highly valuable market-gardening land, locally referred to as the "celery beds". The morainic uplands with time have been subject to soil erosion and have become too dissected in some cases for widespread mechanized grain cultivation.

Although the present population distribution does not reflect the physical environment as closely as it did in the past, the historic location pattern would have had a strong influence on central place status. The towns with the earliest, most productive umlands would gain important initial advantages as district centres. There is a tendency for farmers to retire to the village or town close to his farm, so enlarging the population of central places in densely-settled areas. In these ways the original appeal of the land for the pioneer farmer could influence the present

location and significance of urban centres. Consequently physiography can help to explain the relationship between historical primacy and central place standing observed in preceding sections.

(b). Site Attraction

With the exception of pioneer mill locations discussed in the next segment, the attraction of particular sites has been significant in the development of relatively few central places in Perth and Huron coutnies.

The sites of Goderich and Grand Bend have materially affected their importance as commercial ports and resort centres. Both centres are on relatively wide Lake Huron beaches and are at the mouths of the two most important rivers in the study area. Goderich is an important grain port exporting twenty-seven million bushels annually. Grand Bend serves mainly a resort function; in 1963 thirty people were engaged in the fishing industry, and four hundred and twenty in some facet of the tourist industry.

The mining of salt has been a significant site factor affecting the development of the towns of Goderich and Seaforth, the village of Blyth and the hamlet of Dublin. Although of only historical importance for the latter three places, rock salt mining in Goderich is an eight million dollar a year industry. The quarrying of limestone is an

important part of the economic base of St. Marys; in 1963 the St. Marys Cement Company produced almost twenty per cent of total Ontario cement output. The mining function has undoubtedly contributed to the significance of these centres, the two largest towns in Perth and Huron counties.

The remaining aspect of site attraction, mill site location, is discussed in the next section because of its integral association with the corporate decisions which so significantly affected the location and subsequent development of central places.

4. Entrepreneurial Policies

(a). Mill Sites

A number of centres did not originate out of the needs of the surrounding countryside as central places, but were built in advance of settlement to act as way stations for newly-arrived immigrants. The promotion policies of the Canada Company are particularly notable in explaining the regularity of community spacing along the Huron Road.

It is significant that in the study area eight of the nine city and town sites are on rivers; the other town, Seaforth, is located on a smaller stream. A river site does not appear to be as important a locative factor for villages. Only three of the villages are on rivers, three others are on smaller streams, and the remaining six have no source of water power.

There is strong evidence that the regularity of town spacing along Highway 8 is the result of the fortuitous periodic occurrence of rivers along this first colonizing road (Figure 19) and the Canada Company policy of planning water power sites for urban development, sometimes in advance of settlement. Even if the site for water power were rather unfavourable, as was the case for Stratford and Seaforth, the Canada Company constructed mills at costs that would have discouraged an ordinary promoter.

Extensive swamps originally occupied the present sites of both Stratford and Seaforth. These places developed not only due to the water power potential, but because of the time and equipment needed in fording or bridging these streams, particularly during the spring floods. These conditions may explain why the earliest transport teamster owner, Colonel Van Edmond, found Egmondville south of the Seaforth swamp, such a profitable location. Similar conditions existed at Exeter where the Ausable flooded badly each year.

The founding of other central places reflects the conscious planning of the Canada Company. The village of Sebringville and the hamlet of Dublin were the first water-courses to the west of Stratford and Mitchell respectively, and were developed later as mill sites by the Canada Company (Figure 19). The mill at Egmondville was the second one in

the Huron Tract, and village of Zurich had the first mill in its district.

The importance of stream sites for pioneer settlement is shown in other areas. Some of the earliest settled areas outside of the Huron Tract were along the main watercourses, particularly the Maitland River. However, places north of the Huron Tract were often too far upstream to be of prime water power potential. This factor may help to explain the existence of only two towns in the Queen's Bush portion of Perth and Huron counties.

The importance of water power sites is shown by the proximity of the hamlets of Wroxeter, Gorrie and Fordwich in Howich township. All three centres are within a six-mile section of the Maitland River; the median distance for hamlets in the study area is four miles. The water power potential of the portion of the Maitland is enhanced by the steady flow of water all year due to the abundance of springs in the drumlinized till, and the origin of one of the Maitland tributaries in a lake. The three good dam sites promoted the development of many mills, perhaps inhibiting the dominance of any one of the small settlements over its neighbours.

A similar situation was not as likely to occur in the Huron Tract where the Canada Company had a monopoly on mills. Since the mills were meant to adequately serve the

entire Tract, and not to compete, the Company tended to pick sites far enough apart to avoid an overlapping of service areas.

When surveys were made in the Huron Tract, four town sites were definitely reserved--Stratford, Mitchell, Goderich and Bayfield. The historical primacy of these four centres is evident from Figure 18. Only Bayfield has not developed to town or city status due to its isolation from early traffic routes, the silting up of its harbour, and its proximity to Goderich.

Two other foci of early development, St. Marys and Exeter, have also been postulated as Canada Company towns. Some controversy exists among historians as to whether St. Marys was planned by the Canada Company or developed as a result of individual initiative. The answer probably lies between the two alternatives. It is unlikely that the Company would fail to plan a town at the site of St. Marys where the limestone rock was exposed along the Thames River, forming one of the best water power sites in southwestern Ontario. However, Thomas Ingersoll contracted to build mills here, and when the town plot was surveyed the Ingersolls received most of the fifteen buildings constructed by that time. Because the river lots were reserved for non-farm use, Exeter is said to have been planned and laid out by the Canada Company.

Like the Canada Company, the government played an important part in the selection of mill sites as central place locations. The hamlet of Fordwich was developed later than the hamlets of Gorrie and Wroxeter, being designed by the government as the town plot of Howick. Similarly the nearby location of Wingham seems to have been selected as a mill site at the confluence of the north and south branches of the Maitland; people complained that they were being induced by the government to settle in a "frog pond". Other centres known to have been preselected by the government for settlement were the hamlets of Port Albert, Cranbrook, Poole, Trowbridge and Wallace. Except for the first hamlet it is not known whether water power was the determining factor in their selection.

Figure 19 shows only the mill sites known to the author. Because information on mill sites in Perth and Huron counties is incomplete, it may be presumed that other milling centres developed in Perth and Huron perhaps according to the pattern established in the Huron Tract, i.e. at the junction of major streams and early colonizing roads. If such was the case then the present villages of Blyth and Lucknow probably had milling facilities. Where a power site and early transportation route coincided, the setting for urban development was highly favourable.

(b). Canada Company Way Stations and Surveys

Other settlement policies of the Canada Company may have contributed to a spatial regularity of centres along the Huron Road. During the construction of this highway in 1827 shanties were built at three and one-quarter mile intervals for the convenience of early settlers. This distance probably represented an hour's journey on foot at the normal walking rate of three to four miles per hour. Following completion of the Huron Road, Colonel Van Egmond was contracted to build inns for the accommodation of parties moving into the Tract. Cash bonuses were given to the innkeepers, and they became the Huron Tract's first settlers.

Van Egmond's inns were referred to as ten-mile inns. Two early travellers to the Huron Tract in 1833 and 1853 made note of the regularity: "'On all public roads houses of this kind are conveniently stationed at intervals of six to ten miles.'" "'There is generally a tavern on the roadway every eight to ten miles.'"[1] The ten mile interval may have merely been a convenient distance for Van Egmond's post houses, or it may have been related to the previously-built shanties.

One of the inns, the one at Stratford, was built

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[1]Quoted from E.C. Guillet, Pioneer Inns and Taverns, Vol. IV (Toronto: Ontario Publishing Company, Ltd., 1958), pp. 60 and 74.

near a three and a quarter mile rest station shanty: "'A little after nightfall (we) reached one on Avon Creek kept by an intelligent Irishman. On retiring for the night we were conducted to a shanty thirty or forty yards from the tavern.'"[1] Another of the early inns was at the present site of Clinton, thirty-three miles (i.e. three inns or eleven shanties) west of Stratford. There is little evidence that remaining inns were responsible for initiating other settlements.

The Canada Company's planning of surveys also influenced the pattern of settlement in the Huron Tract. In the townships along the Huron Road, only the first concession was surveyed in 1829. When the rate of population expansion was sufficient to send up the prices of adjacent lands, these were surveyed. The general township survey called for the opening up of concession one in 1829, concessions two and three in 1832, and the remainder in 1835 and 1839. A similar policy of extending settlement along the London Road was followed. Thus initial settlement advanced only one concession back from these early colonizing roads.

This condition is reflected in the founding dates of post offices in Perth and Huron, Figure 18, and helps to explain the late development in sections of Hibbert, Usborne

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[1] Ibid. p. 76.

and Blanshard townships which were most removed from primary roads and surveys. Conversely Tuckersmith township, which fronts on both early roads and which had early surveyed lots on two sides, is entirely within the area developed before 1860. This township, one of the smallest in the study area, contains two towns, one village, and three hamlets, a greater proportion of higher order centres than any other township. Thus the delay in development in areas removed from the colonizing roads may have provided greater impetus for the ascendancy of central places on these routes.

These examples serve to illustrate the profound effects which corporate policy has had on the present distribution of central places.

(c). Examples of Individual and Group Initiative

Since there is an element of indeterminancy in all human behaviour some settlements are located by individuals guided by forces other than geographical site and economic geometry. The desire to be close to people speaking the same language and having the same background was an important factor affecting settlement.

This tendency of immigrants to congregate in national colonies was perpetuated by communications to the Old World

encouraging relatives and friends to move to the newly-settled areas of the Huron Tract. In 1831 an English immigrant cleared some land one and one-quarter miles south of Exeter. The next year he returned to England to induce his friends in Devon to settle, and the whole area around Exeter was settled by Devonshire people.

The western portion of North Easthope township had so many settlers from Perthshire, Scotland that this name was given to the County of Perth on its formation in 1853. The eastern part of North Easthope was settled by Germans coming through adjoining Waterloo county; South Easthope was settled almost entirely by Germans. Early development around St. Joseph, a hamlet north of Grand Bend, may be attributed to a group of French-Canadians from the Eastern Townships, and more particularly to one member of this group, Narscis Cantin. He felt that a canal from Lake Erie to Lake Huron would be built and that St. Joseph could become an important centre on this seaway. He invested one hundred thousand dollars in the St. Joseph area thus helping to initiate and consolidate settlement here.

Two examples of modern individual initiative result in central service anomolies in two centres of Perth and Huron. Bluevale, a hamlet of one hundred and forty-eight people, contains a music shop, a function found in only the

three largest centres in the study area. The owner is a musician who plays for the Wingham television station. Because of his rural upbringing near Clinton, he decided to locate a shop for the sale and repair of instruments away from the town.

The Wingham television station is the only one in the study area. The general manager was born in Wingham and originated a radio station as a hobby. Over a period of thirty-eight years it gradually grew into an important radio-television company. He feels it would not have been built in such a small centre under ordinary circumstances, and that general business prospects could not be credited for its beginning.

The significance of entrepreneurial skill is most marked in its effect upon the railway pattern and resulting urban growth in Perth and Huron. As outlined in a preceding section, community merchants often affected the courses of railways which in turn profoundly influenced the development of the communities.

Two men, Hay and Ballantyne, were important promoters of the transportation network in Elma township. Hay paid forty-five hundred dollars of his own money when Elma could not afford to have the road from Mitchell to Listowel completed. He was determined to have the railway pass

through Listowel where he held property and not the nearby government-planned community of Trowbridge. He and Ballantyne convinced Wallace township and Listowel to contribute sixty thousand and fifteen thousand dollars respectively to bring the railway to Listowel. Elma donated forty thousand dollars in order to have the main line pass through the central portion of the township.

That some other townships did likewise is attested to by the record of their public debts, and the bends in the course of the rail lines north of Stratford (Figure 11).

The hamlets of Wroxeter and Gorrie both voted aid to the Toronto, Grey and Bruce Railway which maintained a station midway between the two. A railway line ran east from Listowel midway between the hamlets of Tralee and Carthage, Hesson and Dorking. Although the line has been abandoned, its effect remains in the proximity of these four hamlets today.

The early railway between Stratford and Listowel was intended to pass through Milverton. Millbank, a more important centre at the time, threatened to boycott the railway if it carried out its plans. Consequently the line was curved from the direct route to Listowel to a position between Milverton and Millbank, creating the hamlet of Newton. Despite these precautions, Milverton was closer to the railway than its rival and gradually gained the advantage.

The delegation of administrative functions by the government in the Queen's Bush and the Canada Company in the Huron Tract were sometimes significant in maintaining or enhancing the status of central places. From the limited data available it appears that the selection of a hamlet as an administrative centre was instrumental to some extent in ensuring its economic stability. Most early township centres still display some vestige of their former importance by the presence of old township offices, meeting halls and township roads maintenance crews. The administrative functions performed by the township centre have so declined or been transferred with time that most township seats in Perth and Huron are of hamlet status.

The dominance of Stratford and Goderich can be partially accounted for by their choice first as district headquarters for the Canada Company, then as the county seats of Perth and Huron. Contrary to the declining role of the township centres, the county seats have assumed more importance with the growing involvement of government in the life of county residents.

The selected illustrations of major factors affecting central place location in Perth and Huron are meant to point out the significance of these factors in a few cases. An overview of historical-geographical distortions of theoretical patterns is presented in the next section.

5. Deviations from Theoretical Central Place Distributions

When the actual distribution of central places (Figure 11) is compared to the two suggested best-fitting theoretical schemes, the grid and the traffic principle (Figure 13 and 17), the following thirteen major differences in spatial patterns may be observed:

1) Theoretically Goderich should have city status.

2) A town should be present north of Goderich at the junction of Highways 21 and 86.

3) According to theory fewer towns are located on Highway 8.

4) The town of Exeter is thirteen miles north of its theoretical position.

5) At least one village should be represented in the area between Lucknow and Goderich.

6) St. Marys should have village rather than town status.

7) A village should be located midway between Wingham and Listowel.

8) The theoretical systems indicate a village south of Grand Bend, 9) south of Mitchell, 10) east of Listowel.

11) The villages of Atwood and Brussels are six miles north of their theoretical positions.

12) Sebringville should have hamlet rather than village status.

13) Hamlets are more numerous and often cluster closer together than theory dictates.

All of these distortions of ideal central place distributions may be explained within the context of the major locative factors discussed in this chapter, and with reference to similar deviations cited by Christaller for southern Germany.

> Central places such as customs, trade places, and harbors, are very frequently located at the borders of a nation. As a consequence of the difficulties and costs of transporting goods across the border, the region which as a rule lies beyond the border . . . no longer serves as the complementary region to the central place in question. Ideally, the complementary region takes the form of a semi-circle.[1]

A graphic illustration of Goderich's "semi-circular" trade area may be seen from Figure 14. When compared to the complementary region of the city of Stratford, Goderich's sphere of influence is as great in length but only covers one-half as much area. The restriction of Goderich's tributary area in an east-west direction has resulted in a north-south extension of the trade area perpendicular to the Huron Road (Highway 8) and parallel to the Bluewater Highway (Highway 21). This situation may help to explain the lack of a village and town location, deviations 2) and 5), to the north of Goderich. This area would be dominated by the harbour town's economic influence thus hindering development of other larger places.

In addition, the area to the north of Goderich has the largest proportion of morainic uplands suggested earlier as

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[1]Baskin, op. cit., p. 46.

being most desirable to pioneer settlers. This type of topography and the many small stream sites seemed to promote development of many hamlets in this region. The area bounded by Highways 21, 8, 4, and 86 had the highest density of hamlets in Perth and Huron counties. In addition to the present twenty hamlets, sixteen former post office hamlets occupied the district (Figure 20).

Just as the topography appeared to encourage the creation of many small central places, it discouraged the locative factors needed to assure the ascendancy of one or more of the hamlets to village or town status, i.e. accessibility to early roads and railways. The colonizing roads, and the railways which tended to follow them, were built on the latter till plain land (Figure 6). Thus isolation from early road and rail development may also explain the lack of a dominant town and village in the area to the north of Goderich.

Similar factors of morainic topography, distance from major road and rail facilities and the proximity of surrounding larger central places could account for the absence of a village south of Mitchell and east of Exeter. The present distribution of centres was, for the most part, established by the 1880's when the rural depopulation took place (Figures 8 and 20). Centres which went out of

existence were those which were not connected with main traffic routes.

The larger centres enjoying improved transportation facilities increased their trade areas farther into the depopulated districts profiting by the decline of the hamlets in these areas. In general the areas well served by rail lines have retained few supply hamlets; thus railways have inhibited the development of new hamlets due to the attraction of business, industry and people to the larger railway centres.

The town status and location of both Exeter and St. Marys may be explained from similar historical conditions. Both sites are thought to have been set aside as original towns by the Canada Company, probably because of their potential water power. Because of their historical primacy and the vested interests of the Canada Company, the earliest railways were directed through these centres. The encouragement of immigration by the Devonshire residents of the Exeter area, and the quarrying of limestone in St. Marys were added incentives to the growth of these central places.

Some of the above comments apply to both the regularity of spacing and the central place status deviations along Highway 8. The median distance between towns on this road corresponds to the median village distance in Perth and Huron counties, and Seaforth is indicated as a village

according to the theoretical grid pattern (Figure 13). The elevation of these places to town status is attributed to historical primacy, water power sites, advantages from early survey and settlement policy of the Canada Company, and early road and rail facilities.

Essentially, however, in terms of the Canada Company regime the urban process for St. Marys, Exeter, and the towns along the Huron Road may be thought of as one largely created rather than evolved. For the Canada Company, for all intents and purposes, planned the location of centres at the junction of major streams and early colonizing roads. Since the Company had a monopoly on mills, the ascendancy of such settlements was practically assured.

According to both the grid and traffic theoretical schemes the village of Sebringville on Highway 8 west of Stratford should have hamlet rather than village status. One may point to advantages outlined in the previous paragraph for an explanation of its position in the hierarchy, but the most important reason is probably Sebringville's non-central function as a dormitory centre for the City of Stratford. "It can be said that a new central place may develop near the central place with higher land costs, especially where the line of traffic enhances its development."[1]

The lack of a village location southeast of Grand Bend and to the east of Listowel may be attributed to late

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[1] Ibid., p. 99.

development in these areas (Figure 18) caused by poor natural drainage conditions. The absence of a village between Listowel and Wingham is in part due to the locations of the villages of Atwood and Brussels north of their theoretical positions. Both of these hamlets reached village status due to the coming of the rail line which deviated from the direct route between Listowel and Wingham in order to bisect townships which contributed to its building costs.

A theoretical village location could be postulated between Wingham and Listowel if one considers the hamlets of Gorrie, Wroxeter and Fordwich in combination. Together they have an activity value of 43 and a population of 878 (Figure 10). These figures are consistent with characteristic values for the village order. The clustering of these hamlets where ideally a village is expected is attributed to the three excellent water power sites and the insistence of early Wroxeter and Gorrie residents that the rail line pass between rather than through either hamlet. The maintenance of a clustering of four hamlets to the east of Listowel (Figure 11) rather than one village also can be explained by the conscious attempt to place the railway midway between existing places.

> When any site, which, contrary to the scheme of the marketing principle, is occupied not by a central place of the expected size, but instead by two or several central places of a lower rank lying closely together, it is probable that the separation principle was responsible.[1]

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[1] Ibid., p. 191.

Contrary to the quotation above, separation in Perth and Huron counties appears to be a result of site geography and individual initiative rather than political boundaries.

Finally, the A order centres are more numerous in the study area than in the theoretical distribution of central places. If single and double-activity centres are considered as auxiliary rather than central places then hamlet numbers in the study area are more consistent with theory and their median distance is identical to the theoretical distance for this order. An examination of the basis for these ideal distances concludes this chapter.

6. Basic Distance-Time Considerations

Table 9 points out similarities between spatial results derived from Christaller's hierarchy in southern Germany and the distances found in Perth and Huron counties. The town distance of 23 miles for Perth and Huron is more accurate than the median which is affected by town distances on Highway 8. In the previous sections it has been shown that town development on this route is atypical of both the theoretical distribution and the spacing of towns other than those on the Huron Road. The 23 mile distance corresponds closely to the theoretical town distance of 22.6 miles.

With the exception of Christaller's township centre category, there is a notable similarity between distances

of different orders in southern Germany and Perth and Huron counties. This similarity is even more remarkable when one considers that great differences in area, population density, cultural patterns, urban history, income levels, and topography exist between the two study areas. One may account for the correlation between urban grade distances by either claiming a fortuitous similarity largely due to divergent methods of arriving at a hierarchy, or by asserting a basic time-distance factor which may be, or have been, operative in very different regions.

Many researchers, including Christaller, take the latter appraoch.

> Obviously, there must be some basic time-distance measure, and it must be one which is determined by the time it takes for a person to go a certain distance. Let us imagine a colonial land which is to be thoroughly settled. Certain prominent points on the landscape--bays, conspicuous points along rivers, forests with fertile soil, etc.--are starting points at which settlement may originate. Those places within a day's travel of these starting points will belong to this region. Such places can be no more than 35 to 40 km. 22 to 25 mi. apart. Other places which a person can reach and return from in one day will have a special rank. They will lie about 20 km. 12.4 mi. from the starting points.[1] (Itallics mine.)

> For settlements of rural service-centre type it has been argued that, since a majority of them originated during the era of poor roads and horse and buggy transportation, their present spacing indicates the convenient distance a farmer could drive a horse to market and return within about a half day's time.[2]

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[1] Ibid., p. 118.

[2] G.T. Trewartha, "The Unincorporated Hamlet," Annals of the American Association of Geographers, XXXIII (1943), p. 52.

> In England this system has developed from the early medieval pattern of market centres at intervals of four to six miles accessible by cart from the nearest small town in one hour. In the early nineteenth century, before the advent of the railroad, hamlets developed in Wisconsin under essentially the same conditions as in medieval England at intervals of five to six miles as rudimentary service centres for the farmers who lived within one journey hour by wagon roads.[1]

In addition Christaller points out that the distances apart of central places arranged on main routes according to the traffic principle in his country are often equidistant stopping places, i.e. posts on the route a day's march apart. He cites another researcher who found this distance to be equivalent to thirteen miles.

For Christaller the basis of the entire spatial system is the distance travelled in one hour: "Clearly, the pure time-measure has an important geographical effect, for it basically determines the number and distribution of the central places."[2]

The basic distance factor will vary in time with changes in the means of transportation. The median distance apart of former post office hamlets (Figure 20) was 3.5 miles compared to the modern median A order distance of 4.0 miles or 6.3 miles if one excludes single and double-activity centres as auxiliary places. The three and a quarter mile shanty distance and ten mile inn distance appear no longer

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[1]Dickinson, op. cit., p. 119.

[2]Baskin, op. cit., p. 160.

relevant to the present spatial pattern in Perth and Huron.

> Let us assume that a system was originally formed according to a standard day's walk of 20 km. Then perhaps a fundamental change in the most significant mode of transportation occurred. . . . Either the old basic measure of 20 km. was rooted so deeply in the minds of the population . . . or, if the system was still young and not solidified and the 20 km. measure was not rooted so firmly in the minds of the population, the system will be converted to the new time-measure.[1]

However Christaller makes the point that fundamental time-distances are those which were operative in the formative settlement period.

> The establishment of any point (to be exact: of two points) on the earth's surface as a central capital or other important place determines simultaneously an entire system of central places . . . Thus, the rule is that the older system previously determined always determines the more recent system developed under other economic laws and conditions.[2]

The earliest starting points in Perth and Huron, Stratford and Goderich, are 46.2 miles apart. These are almost ideally placed according to grid and traffic theoretical city distances of 46 and 45.2 miles respectively. The examples cited by Christaller for the colonial situation in the first quotation in this section correspond very closely to both measured and theoretical distances in Perth and Huron counties.

One further observation on basic distances concerns the fairly standard Ontario township dimensions of six by twelve miles. When the boundaries of the twenty-seven townships in

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[1] Ibid., p. 119.

[2] Ibid., p. 122.

Perth and Huron are measured and tabulated the most frequent distances are 6, 9 and 12 miles occurring in 7%, 23% and 18% of the cases respectively. Since even the most frequent distances do not account for fifty per cent of the measured township dimensions, they can hardly be regarded as characteristic of a standard township size in the study area. However the measurements were made in order to test for a relationship between township dimensions and central place spacing since the six by twelve township distances are suggestive of theoretical basic distances of 6.2 miles for hamlets and 12.4 miles for villages.

Before 1840

1840-1850

1850-1860

1860-1870

1870-1880

After 1880

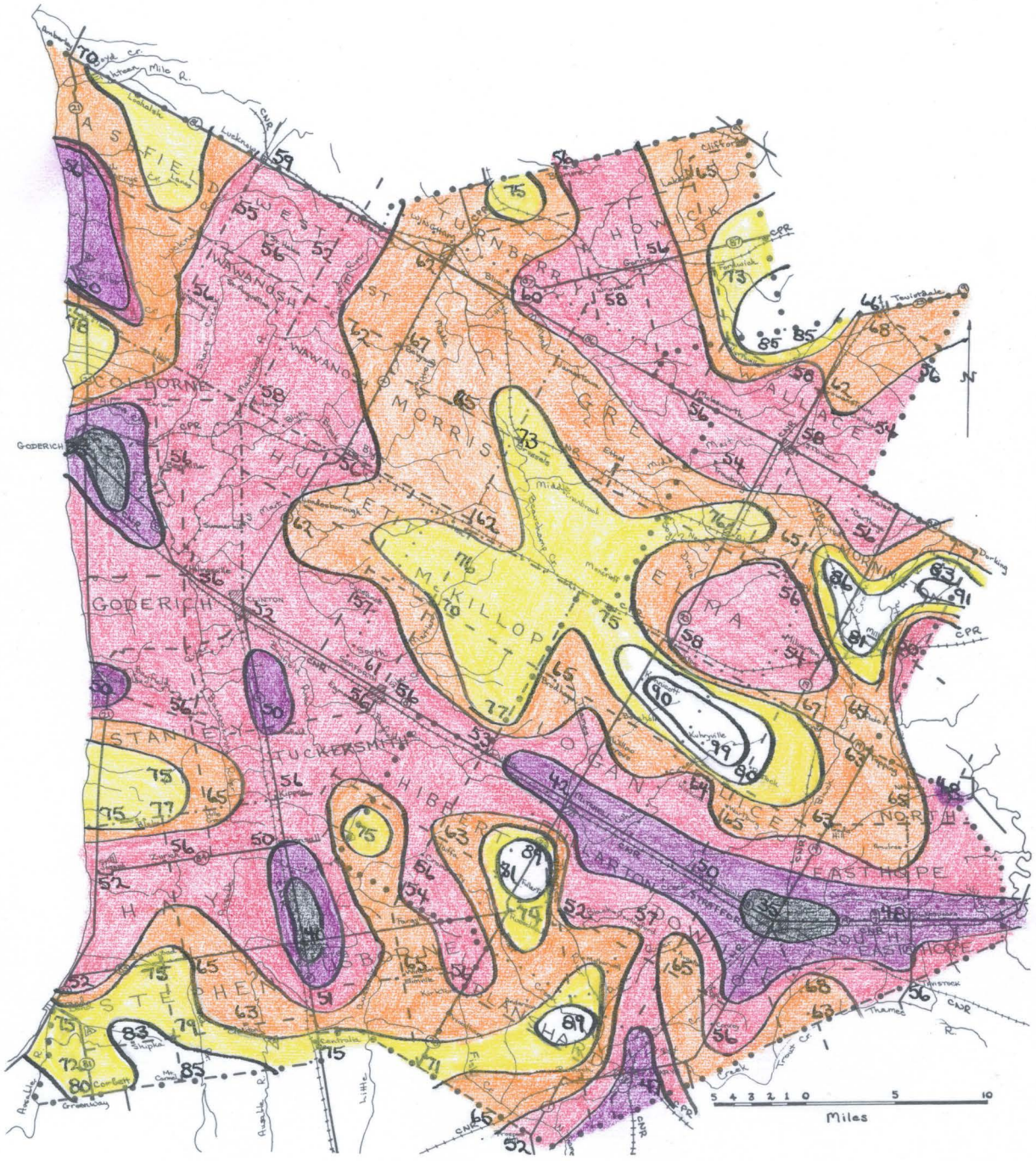

FIG. 18 Post office founding dates

TABLE 8

POST OFFICE FOUNDING DATES BY CENTRAL PLACE ORDERS

Period of Post Office Creation	Number of Present Central Places			
	Hamlets	Village	Town	City
1830 - 1839	1	0	1	1
1840 - 1849	2	0	3	
1850 - 1859	33	8	3	
1860 - 1869	27	1	1	
1870 - 1879	10	3		
1880 - 1890	11			
Range	1839 - 99	1850 - 76	1833 - 62	1835
Median	1862	1856	1850	

Fig. 19 Early roads and mill sites

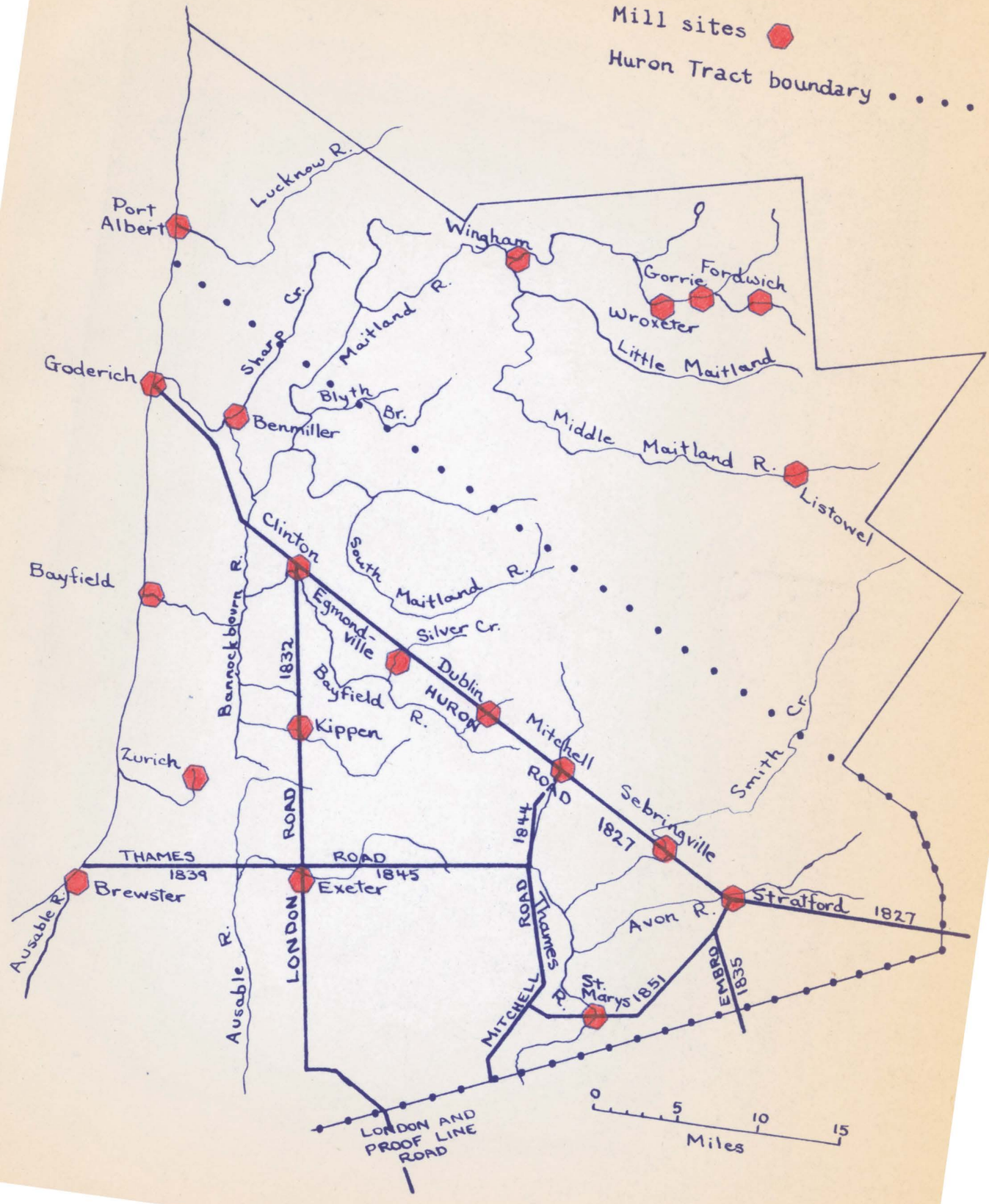

Fig. 20 The distribution of former post offices which do not exist as present central places

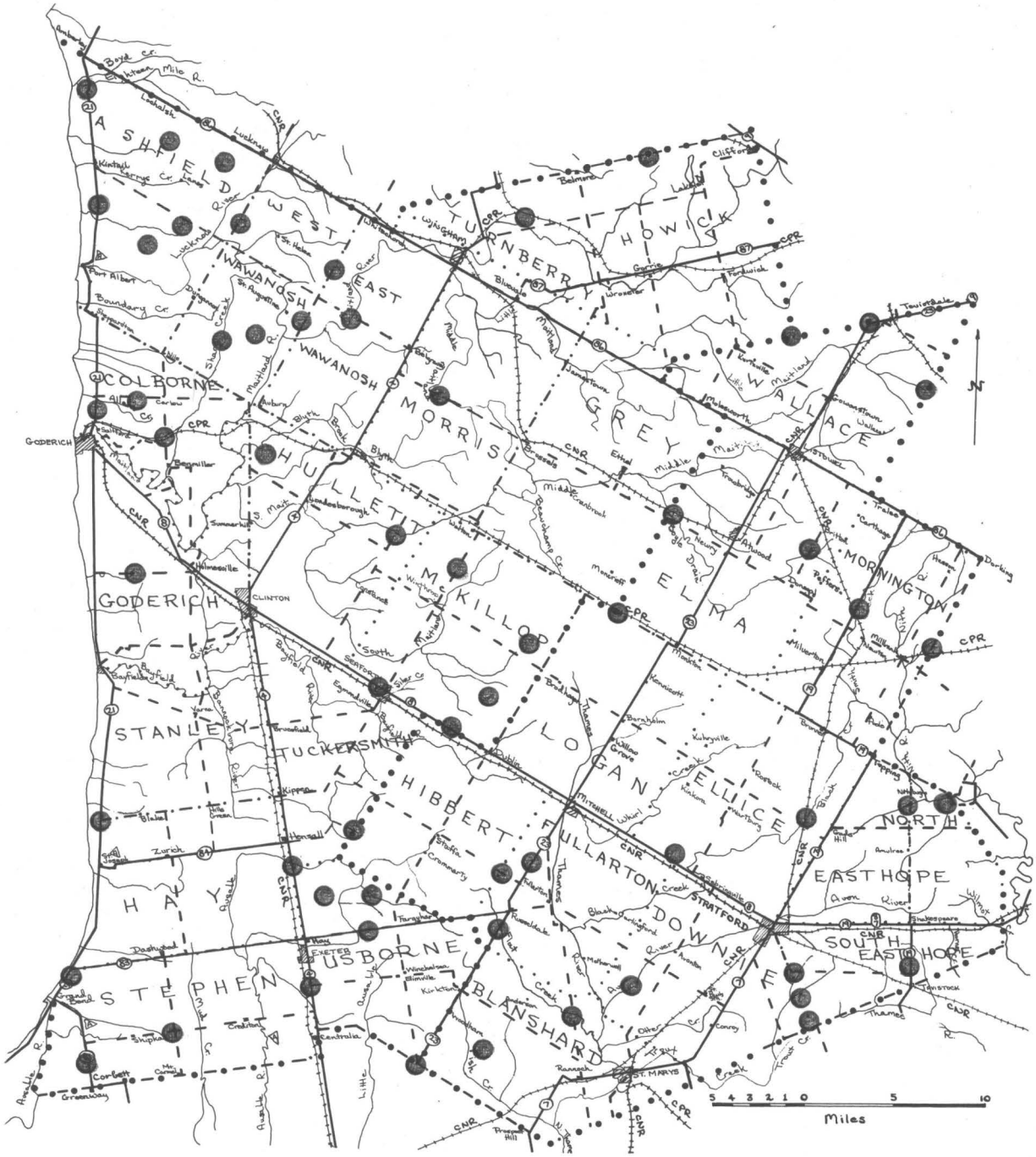

TABLE 9

A COMPARISON OF THE DISTRIBUTION OF CENTRAL PLACES IN PERTH AND HURON COUNTIES AND IN SOUTHERN GERMANY (ACCORDING TO CHRISTALLER)

Order of urban Centres in southern Germany[a]	Distance apart (miles)	Distance apart (miles)	Order of centres in Perth and Huron counties
Market town	4.5	4.0	Hamlet
Township centre	7.5		
County seat	13.0	13.0	Village
District city	22.5	19.0[b] 23.0[b]	Town
Small state capital	39.0	32.5	City

[a]Terminology and distances are taken from Raymond E. Murphy, The American City (New York: McGraw-Hill, Inc., 1966), p. 77.

[b]The most frequent town distance is shown as well as the median town distance.

CHAPTER VI

CONCLUSIONS

> Hence, the theory has a validity completely independent of what reality looks like, but only by virtue of its logic and "the sense of adequacy". . . . When this eo ipso theory is confronted with reality, it becomes clear to what extent reality corresponds to theory, to what extent it is explained by it, and in what respects reality does not correspond with the theory and is therefore not explained by it. The unexplained facts must then be clarified by historical and geographical methods, because they involve personal, historical, and naturally conditioned resistances--factors which cause deviations from theory. They have nothing to do with the theory itself, and above all cannot be cited directly as proof against the validity of the theory.[1]

1. The Hierarchy of Central Places

On the basis of the cumulative complexity of sixty selected activities in the service centres of Perth and Huron counties, it is possible to recognize at least four sets of central places. For each order the quantitative functional variations between classes are greater than the differences within the groups.

The emergence of convenient service centre categories or levels is partially an outcome of the method used and the area selected. Other methods involving indices of service specialization proved unsatisfactory for a recognition of

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[1] Baskin, op. cit., pp. 4-5.

graded central places. A differentiation between the two lowest class centres is not possible by using only the fifty central service functions; the ten additional non-central functions effected a clear distinction between these levels, and enlarged the intervals between higher orders.

With an increased amount of functional data it becomes easier to both recognize grades and identify services characteristic of each central place class. Separation of urban grades is more difficult at lower levels which have fewer differentiating criteria. Perhaps additional data from a larger study area would cause further division within the four orders or necessitate a complete revision of the suggested groupings. Such a possibility is acknowledged by Hans Carol in his study of a hierarchy of city business centres: "A more detailed survey would have to establish sub-categories in order to represent existing conditions more faithfully."[1]

Certainly a very slight expansion of the study area to include the village of Palmerston would complicate the determination of central place grades by contributing to a continuum of activity values between the villages and towns of Perth and Huron.

The orders of central places derived from an inventory of types of business and service establishments do exhibit

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[1]Carol, op. cit., p. 421.

common characteristics apart from their quantitative point-score totals. A strong positive relationship exists between the population of a centre and its complexity of functions. Although the population difference between the two lower orders is not readily apparent by the rank-size rule, quite discrete population levels typify the other classes. These population limits closely correspond to census definitions or government requirements for legal incorporation. Consequently the orders of service centres in Perth and Huron counties have been designated as city, town, village and hamlet. The high correlation between population size and functional specialization confirms a tenet of theory that well-defined population-function relations characterize a system of centres where the major economic base of these centres consists of central place functions.

Also consistent with central place theory is the fact that higher order centres are fewer in number, farther apart, and functionally more specialized. Both the type and number of businesses increase with higher position in the hierarchy. Trade areas are generally larger for high order centres, but are neither precise, nor discrete. There is evidence of a correlation between high position in the hierarchy and superior transportation facilities. This condition is suggestive of a hierarchy of routes corresponding to central place grades.

On the basis of arbitrarily-selected significance levels it is possible to recognize trait complexes for each order. Although higher order centres contain the standard assemblage of lower order activities, seventy per cent of these activities are considered characteristic of individual orders. Moreover there appears to be an arithmetic progression of the average number of activities in each order. The number of people which support each activity in the different urban classes seems to increase geometrically. The exponential progression in the number of central places per order suggested by Christaller is far less clear.

2. Spatial Patterns

The spacing of service centres in Perth and Huron counties does have an underlying uniformity suggestive of a central place scheme. Pairs of higher status centres are farther apart than pairs of lower order status. There is evidence of the exponential regularity propounded in theory. Generally there is a wreath-like pattern of lower order surrounding higher order centres, but central places are not located according to a uniform hexagonal distribution. Central places do not appear to serve six equal and equidistant hexagonal trade areas of a lower order.

The Christaller principle which yields theoretical distance and number values most consistent with empirical

results) is the traffic principle. The historical development in the study area reflects the important role of transportation routes and is therefore consistent with the dominance of the traffic theorem. However other geometrical patterns or models, such as a rhomboidal distribution which corresponds to the township survey pattern, may be just as applicable to the situation in Perth and Huron counties.

3. Historical-Geographical Locative Factors

> Thus, we cannot disregard the historical method, either for special investigations of monographical character, or for general investigations in which the historical method only enables us to understand the ideas of an economy and the concrete economic system born out of it, as a rule, at the time of the creation of the towns. . . . the results obtained . . . by the historical method correspond in a high degree to those obtained here by the economic method.[1]

Empirical support for some tenets of central place theory does not conclusively validate the theory since other explanations are possible. Factors other than space-size-activity relations may be dominant in establishing the areal organization of service centres. The transportation and administrative influences which are said to distort ideal patterns often account for the regularity ascribed to central place theory.

Many central places owe their inception and development to sometimes probabilistic decisions by agents of settlement promotion, decisions which may defy explanation according to

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[1]Baskin, op. cit., p. 200.

the central place scheme. In historical fact, alternate explanations to central place theory, such as administrative policies, land resources, entrepreneurial skill, transportation facilities, and even whimsical chance, seem both appropriate and plausible. Yet basic time-distance factors suggested by Christaller and others may underlie the regularity of some of these historical locative factors.

Returning to the quotation with which this chapter began, if one assumes Christaller's theory and his arguments regarding deviations from it, the service centre pattern in Perth and Huron counties can be considered consistent with his number-function-spatial theorems. If one presumes that historical-geographical site location factors are prime rather than deviant influences, much of the regularity attributed to economic theory can be explained.

> Whether history is lawful is a matter for those who write it to decide. That spatial processes occur, to which the historian could not contribute understanding but which are the very stuff of geography, appears self-evident--or at least a worthy article of faith.[1]

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[1] Leslie Curry, "The Random Spatial Economy: An Exploration in Settlement Theory," Annals of the Association of American Geographers, LIV (1964), p. 146.

APPENDIX I THRESHOLD VALUES FOR CENTRAL SERVICE FUNCTIONS

	Central Service Function	Total Functional Units	Threshold Activity Value	Threshold Population Values
1.	Food store	235		
2.	Auto service station	222		
3.	Restaurant	98	1	50
4.	Insurance agent	86	2	50
5.	Hairdresser	78	2	50
6.	Furniture/appliance store	76	2	50
7.	Hardware	73	2	50
8.	Physician	53	4	63
9.	Farm equipment	52	4	65
10.	Auto dealer	50	5	70
11.	Bank	48	5	75
12.	Builder's supply	43	6	94
13.	Hotel	37	7	134
14.	Drug store	33	9	179
15.	Cold storage	31	9	216
16.	Funeral home	30	11	235
17.	Shoe store	29	12	267
18.	Bowling/billiards	28	13	292
19.	Retail bakery	27	13	301
20.	Veterinary	25	14	319
21.	Men's apparel store	24	14	395
22.	Women's apparel store	24	14	395
23.	Variety store	23	14	418
24.	Law firm	23	14	418
25.	Retail auto supplies	20	20	429
26.	Library	18	22	520
27.	Jewellery store	18	22	520
28.	Nursing home	17	25	557
29.	Weekly newspaper	17	25	557
30.	Hospital	15	26	724
31.	Family apparel store	14	28	844
32.	Dep't. store order office	14	28	844
33.	Optometrist	13	30	906
34.	Finance company	13	30	906
35.	Dentist	13	30	906
36.	Soft furnishings	12	31	926
37.	Department store	11	34	1031
38.	Gift shop	11	34	1031
39.	High school	10	37	1111
40.	Liquor store	10	37	1111
41.	Florist	10	37	1111
42.	Chiropractor	10	37	1111
43.	Children's apparel	9	38	1232
44.	Accountant	8	46	2247
45.	Photographer	7	46	2252
46.	Book shop	6	51	2922
47.	Theatre	4	56	3491
48.	Music shop	3	56	4002
49.	Sewing centre	1	60	6411
50.	Business college	1	60	6411

APPENDIX II

Calculation of Extreme Mean Significance Values

Dixon lists critical values for the extreme mean for a 95 per cent confidence level, asserting that his method will accept or reject extreme average values correctly in 95 out of 100 cases. If the ratio computed from the formula is greater than the critical value, then the mean tested is considered "extreme" and a member of a different set of observations. If the ratio is less than the critical value, then the gap between the mean and the group with which it has been tested is not significant and the mean index is considered a part of the group. One example is presented below.

Goderich has a centrality index of 15.45. The nearest observations to it are Grand Bend, Listowel, St. Marys and Exeter with indices of 10.67, 10.37, 10.36 and 10.27 respectively. Wingham's index is 8.71 which seems to depart from the above set and can be tested as well for extreme value.

To determine whether the index given for Goderich is sufficiently large to warrant its not being included in the group containing Grand Bend, Listowel, St. Marys and Exeter the following formula is used:

$$r = \frac{\bar{X}_2 - \bar{X}_1}{\bar{X}_k - \bar{X}_1}$$

where $\bar{X}_1$ is the mean to be tested for extremeness, $\bar{X}_2$ is the mean closest to it in value and $\bar{X}_k$ is the mean farthest from it in value when the means have been arranged in order of size.

Thus for Goderich $r = \frac{10.67 - 15.45}{10.27 - 15.45} = .923$

This exceeds the critical value reported by Dixon of .642 for five means at the 5 per cent level of significance. Consequently it is possible to assert with a 95 per cent level of confidence that the centrality index for Goderich does not belong to the same set of indices as the other four considered above. Therefore the break in centrality values between Goderich and these other places is significant and they do not belong to the same group.

Similarly it may be shown that the centrality index for Wingham differs significantly from that of Grand Bend, Listowel, St. Marys and Exeter, consequently Wingham does not belong to this group of centres.

APPENDIX III

Spearman's Coefficient of Rank Correlation between population [column (1)] and central service functions [column (2)], and population and functional units [column (4)]. Columns (3) and (5) show the values of d_1 and d_2 the difference between the ranks (1) and (2), (1) and (4) respectively. The letters in the left column are the first letters of the ranked centres; thus G, S, L signify Goderich, St. Marys and Listowel.

The symbol ' indicates a tied score and represents .5 .

	(1)	(2)	(3)	(4)	(5)
G	1	1	0	1	0
S	2	3'	1'	3	1
L	3	2	1	2	1
C	4	6	2	4	0
E	5	3'	1'	6	1
W	6	5	1	5	1
S	7	8	1	7	0
M	8	7	1	8	0
T	9	14	5	11	2
M	10	10	0	13	3
L	11	9	2	10	1
H	12	15'	3'	16	4
G	13	13	0	9	4
B	14	11	3	12	2
B	15	12	3	15	0
Z	16	15'	'	14	2
C	17	17	0	18'	1'
S	18	20	2	20	2
D	19	22'	3'	24'	5'
C	20	33	13	30	10
E	21	51'	30'	46'	25'
M	22	18	4	17	5
A	23	19	4	18'	4'
B	24	27	3	22'	1'
G	25	21	4	22'	2'
D	26	27	1	24'	1'
W	27	24	3	26	1
S	28	27	1	29	1
F	29	22'	6'	21	8
M	30	27	3	32	2
A	31	27	4	27'	3'
K	32	39	6	35'	3'
C	33	33	0	27'	5'
D	34	33	1	31	3
B	35	43'	8'	38'	3'
B	36	33	3	39	3
E	37	33	4	34	3
B	38	39	1	38'	'
N	39	51'	12'	46'	7'
L	40	33	7	37'	2'
B	41	39	2	43'	2'
S	42	58'	16'	51'	9'
M	43	43'	'	46'	3'
R	44	43'	'	43'	1'
W	45	51'	6'	46'	1'
G	46	43'	2'	49	3
W	47	39	8	33	14
V	48'	51'	3	41'	7
T	48'	58'	10	56'	8
H	50	58'	8'	56'	6'
S	51	51'	'	51'	'
C	52'	51'	1	51'	1
S	52'	51'	1	51'	1
A	54	58'	4'	56'	2'
W	55	33	22	33	22
B	56	39	17	40	16
N	57	51'	6'	51'	5'
L	58	58'	'	56'	1'
C	59'	58'	1	51'	8
T	59'	51'	8	46'	13

$n^3 - n = 216{,}000 - 60 = 215940$

$$r_s = 1 - \frac{6\,(\Sigma d^2)}{n^3 - n}$$

$d_1^2 = 3136.75$	$d_2^2 = 2615.0$
$r_s = 1 - \frac{18820.5}{215940}$	$r_s = 1 - \frac{15690}{215940}$
$= 1 - .087156$	$= 1 - .072659$
$= 0.912844$	$= 0.927341$

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Fig. 11 Road, rail and central place distribution

TABLE 2.

C and B

	Number of functions	Goderich	Listowel	St. Marys	Exeter	Wingham	Clinton	Mitchell	Seaforth	Lucknow	Milverton	Brussels	Blyth	Tavistock	Grand Bend	Hensall	Zurich	Clifford	Atwood	Monkton	Sebringville
		C								B											
TOTAL ACTIVITIES		60	57	56	56	52	51	46	46	38	37	34	31	30	28	26	25	25	22	21	20
POPULATION		6411	4002	4482	3047	2922	3491	2247	2252	1031	1111	844	724	1232	906	926	723	557	418	422	520
Food store	113	13	4	5	6	9	7	7	8	8	3	7	3	4	5	3	5	2	3	2	1
Automobile service station	80	15	13	12	7	5	12	6	8	5	3	3	3	5	8	7	6	2	2	4	3
Hardware	38	6	3	3	4	4	4	5	4	3	2	2	1	2	1	1	2	1	2	2	1
Bank	35	3	3	3	2	2	2	2	3	1	2	1	1	1	1	1	1	1	1	1	B
Farm equipment	35	2	2	3	2	2	4	2	1	1	2	2	1	2	1	2	2	1		2	1
Restaurant	34	7	7	9	3	4	5	3	2	3	2	3	2	2	20	2	2	2	1	1	
Insurance agent	28	14	8	4	4	2	4	3	9	2	1	2	3	4	7	1	4		2	1	1
Builder's supply	27	3	2	3	2	2	4	3	2	2	1	1		1	1	2	1	2	1		1
Cold storage warehouse	26	2	1	1	1	1	2	2	1	2		2	1		1		1	1	1	1	1
Hairdresser	25	10	7	5	6	8	3	4	7	5	1	3	1		4	1	1	1	2	1	
Hotel	22	3	2	2	2	1	2	1	2	1	1	2	1	2	5	1	2	1			1
Automobile dealer	21	8	5	7	4	3	3	2	2	1	2	1	1	.1	2	1	1	2		1	1
Retail bakery	21	1	1	1	2	2	1	1	2	1	2	1		3	1	1	1	1		1	
Furniture/appliance store	21	9	6	9	5	6	8	4	5	3	2		5	3	1	1		1	2		2
Funeral home	20	2	2	2	2	2	2	2	3	1	1	1	1	2		1	1	1	1		
Physician	20	8	3	5	4	4	6	2	3	1	2	1	1	6	1	1		1	1	1	1
Drug store	18	4	2	4	4	2	2	2	2	1	1	2	1	1	1	1		1	1	1	
Library	18	1	1	1	1	1	1	1	1	1	1	1		1		1		1	1	1	
Weekly newspaper	17	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1			1	
Veterinary	17	1	4	1	1	1	1	1	4	1	1	2	1	2			1		1		1
Bowling/billiards	17	1	3	2	2	2	3	2	2	1	1		1		2		1			2	
Variety store	16	3	2	1	1	3	1	1	2	1	1	2	1	1	1			1			
Shoe store	14	5	4	3	1	3	3	2	2	1	1	1	1				1				
Law firm	14	3	3	2	2	2	1	2	2	B	1	B	B				1	1			
Nursing/rest home	13	1	1	1	1	1		3	2	1	1	1		2		1			1		
Men's apparel store	13	4	3	3	1	3	2	1				1	1		1	1					2
Jewellery store	12	4	2	2	2	1	2	2	1	1	1	1		1							
Family apparel store	10	1	1		2	2	1	1	2	2			1							1	
Government liquor store	10	1	1	1	1	1	1		1		1				1		1				
High school	10	1	1	1	1	1	1	1	1	1	1										
Department store	10	1	1	1	1		1	2	1	1	1										1
Florist	9	1	1	1	2	1	1	1	1	1											
Women's apparel store	9	5	4	3	2	3	3								2	1					
Gift shop	9	1	1	1	1	2	3	1	1						8						
Hospital/medical clinic	8	1	2	2	2	2	2	2	2												
Optometrist	8	3	2	2	1	2	1		1					1							
Chiropractor	8	1	1	2	1	2	1	1													
Retail auto. supplies	8	2	5	2	3	2	3	2	1												
Dentist	7	3	1	2	2	3				1	1										
Soft furnishings	7	2	1	2		1	2	1	2			1									
Department store order office	7	2	2	2	2	2	2		2												
Children's apparel store	7	2	1	1	1	2		1					1								
Photographer	6	2	1	1	1	1		1													
Finance Company	6	4	2	2	3		1					1									
Book shop	5	2	1	1	1		1														
Theatre	4	1	1	1	1																
Accountant	3	3	3		2																
Music shop	3	1		1																	
Sewing machine sales/service	1	1																			
Business college	1	1																			
TOTAL FUNCTIONS		50	47	46	46	42	41	38	37	31	29	27	24	22	23	20	20	19	16	17	15
TOTAL FUNCTIONAL UNITS		1735	124	118	100	102	108	785	95	54	395	45	33	47	73	31	355	225	225	23	17
ATTRIBUTES																					
Post offices	64	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Feed/seed/grain mills	50	2	3	3	3	2	2	3	2	1	3	2	2	3		3	1	2	1	2	1
Railway stations	40	2	2	2	1	2	2	1	1	1	1	1	1	1		1		1	1	1	1
Telephone exchanges	30	B	B	B	B	B	B	B	B	B	L	L	L	B	L	B	L	L	B	B	L
Dairy processing plants	22	1	1	1	1	2	1	1	1	1	1	1	1	1				1	1		
Truck transport lines	22	3	3	2	1	2	3		1	1	2	1	2	1			1	1	1		
Public utilities offices	12	2	2	2	2	2	2	1	1		1			1	1	1					
Taxi service	10	2	2	1	1	1	1	1							1						
Government offices	7	3	2	1	1	1	3		2												
Incorporated centres	17	T	T	T	T	T	T	T	T	V	V	V	V	V	V	V	V				V

A (part 1)

	Gorrie	Fordwich	Dashwood	Dublin	Auburn	Shakespeare	Wroxeter	Millbank	Bayfield	Centralia	Crediton	Dungannon	Ethel	Brucefield	Londesborough
TOTAL ACTIVITIES	15	15	14	14	14	13	13	13	12	11	9	9	9	9	8
POPULATION	319	267	433	301	216	309	292	235	395	179	429	166	134	133	113
Food store	3	4	3	3	2	2	2	2	4	4	3	2	1	1	2
Automobile service station	2	2	2	2	3	2	2	1	3	3	1	3	2	2	2
Hardware	1	1	1	2	1		1	1	1		1	1	1		1
Bank	1	B	B	1	1	B	1	B	B	B	1	B		B	B
Farm equipment	1		1		1			1		1					1
Restaurant		1	1	2	1	2	1			1		1		1	
Insurance agent		2		1			1		1		1	1			
Builder's supply	1		1		1	1	1	1						1	
Cold storage warehouse			1	1		1		1	1				1		1
Hairdresser	1	1		1		1	1		1		2				
Hotel				1		1			2	1					
Automobile dealer														1	
Retail bakery	1	1	1				1								
Furniture/appliance store	1				1			1					1		
Funeral home	1		1		1										
Physician	1														
Library		1											1		
Weekly newspaper		1													
Bowling/billiards	1	1				1									
Variety store								1							
Shoe store			1												
Women's apparel store									1						
Chiropractor							1								
TOTAL FUNCTIONS	12	11	11	9	9	9	10	9	9	6	6	6	6	6	6
TOTAL FUNCTIONAL UNITS	14	15	13	13	10	10	12	8	145	105	9	85	7	55	6
Post offices	I	I	I	I	II	II	II	I	I	I	I	II	II	II	II
Feed/seed/grain mills		1	1		1	1		2		1	1	1	1	1	1
Railway stations	1	1		1	1	1	1	1		1			1	1	
Telephone exchanges		L	L	L	L	B	L		L	B	B	L			
Dairy processing plants				1				1							
Truck transport lines	1			1	1										
Taxi service									1	2					

A (part 2)

	Walton	Whitechurch	Belmore	Kirkton	Bluevale	Belgrave	Brodhagen	Rostock	Staffa	Kurtzville	Brunner	Newton	Molesworth	Hay
TOTAL ACTIVITIES	8	7	7	6	6	6	6	6	6	6	6	5	5	5
POPULATION	62	77	57	182	148	143	104	92	66			128	94	
Food store	2	3	2	3	2	4	1	1	1	1	1	1	1	1
Automobile service station	2	1	1	2	2	1	1	1		1	2	2	2	3
Hardware	1	1				1	1	2						
Bank				B										
Farm equipment	1		1							1	2			
Restaurant	1	1												
Insurance agent			1				1							
Builder's supply										1				1
Cold storage warehouse									1				1	
Automobile dealer						1								
Veterinary				1										
Men's apparel store	1													
Music shop					1									
TOTAL FUNCTIONS	6	4	4	4	3	4	4	3	2	4	3	2	3	3
TOTAL FUNCTIONAL UNITS	25	55	45	65	5	65	35	35	4	35	45	3	3	5
Post offices	I	II	II	II	II	II	II	II	II	II	II	II		II
Feed/seed/grain mills		1	1	1	1		1	1	1	1	1	1	1	
Railway stations	1	1									1	1		1
Dairy processing plants					1			1	1				1	
Truck transport lines			1			1			1					

A (part 3)

	Hannoch	Woodham	Gadshill	Varna	St. Pauls	Bornholm	Gowanstown	Ben Miller	Kippen	Newry	Amberley	Prospect Hill	Holmesville	St. Joseph	Shipka	Poole	Westfield	Dorking	Lakelet	Carlingford	Britton
TOTAL ACTIVITIES	5	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	3	3
POPULATION		85	80	75	65					56											
Food store	1	1	1	2	1	1	1	1	1	1	1	1	1		1	1		1	1	2	1
Automobile service station	1	2	1	2	1	1	1	1	1	1	1	2	1	1	2	2	1	2	1	1	
Hardware											1										
Farm equipment	1					1		1									1				
Restaurant			1									2		1							
TOTAL FUNCTIONS	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2	2	2	2	2	2	1
TOTAL FUNCTIONAL UNITS	25	3	25	4	2	25	2	25	2	2	3	45	2	15	3	3	15	3	2	3	1
Post offices		II	II	II	II	II	II		II							II				II	II
Feed/seed/grain mills	1	1		1				1							1		1	1	1		
Railway stations	1				1		1		1				1								1
Dairy processing plants										1											

A (part 4)

	Egmondville	Saltford	Trowbridge	Cranbrook	Lochalsh	Cromarty	Teviotdale	Greenway	Nile	Willow Grove	Jamestown	Donegal	Carthage	Tralee	Constance	Farquhar	Peffers	Motherwell	Port Albert	Winthrop	Topping	Kintail	Moncrieff
TOTAL ACTIVITIES	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
POPULATION	420	98	75	65	53	50	50																
Food store	2	1	1	1	1	2		1	1		1	1	1	1	1	1	1	1	1	1		1	1
Automobile service station	1	1		1			2	1	1	1	1	1	2	1	1								
Farm equipment										1											1		
Restaurant							1																
Insurance agent																1							
TOTAL FUNCTIONS	2	2	1	2	1	1	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
TOTAL FUNCTIONAL UNITS	3	2	1	2	1	2	3	2	2	2	2	2	3	2	2	2	1	1	1	1	1	1	1
Post offices			II		II	II												II	II			II	II
Feed/seed/grain mills																				1			
Railway stations																	1						
Truck transport lines																					1		

INSERT

	Hesson	Amulree	Russeldale	Corbett	Nithburg	Hills Green	Mount Carmel	Kennicott	Blake	Kinkora	Wartburg	Kuhryville	Wallace	Elimville	Winchelsea	Summerhill	Lanesville	Anderson	Sheppardton	St. Augustine	St. Helen	Fullarton	Carlow	Conroy	Avonton
ACTIVITIES	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
POPULATION	70	63																							
Food Store	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1