

"REVIEW IN THE DEVELOPMENT OF CENTRAL PLACE THEORY
- A POSITIVE APPROACH" -

B.A. THESIS

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- 1966 -

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"A REVIEW IN THE DEVELOPMENT OF CENTRAL PLACE THEORY
- A POSITIVE APPROACH"

A. Introduction:

That urban settlements differ one from the other is readily discernible and provides little opportunity for constructive debate. That these centers serve, basically, the same needs (shelter, protection, center of agglomeration and distribution of goods and services) is acknowledged; but the crux of the matter seems to lie in the "how and the why" of the problem (structure, morphology and combination of activities characteristic of the center).

Until a few decades ago, urban geographers tended to exhibit a natural preoccupation with the internal structure of settlements. More recently, attention has been focused upon the size, spacing and functional complexity of cities. The greatest impetus in this direction came from the works of Walter Christaller,¹ a German Geographer, who produced the first comprehensive piece of literature on Central Place Theory.

A highly theoretical framework had been cast one hundred years earlier, with the publication in 1826, of Von Thünen's,² "Der Isolierte Staat", in which he postulated, assuming the existence of uniform conditions in the area, that the development of a city would occur in the center of the land mass and concentric rings of land use would emerge around this nuc-

1. W. Christaller, Die Zentralen Orte in Suddeutschland (Jena, 1933), trans. - C. Baskin at the Bureau of Population and Urban Research, University of Virginia, (1957).
2. J. H. von Thünen, Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, Rostock, 1826.

leation depending upon the economic rent of the products or crops concerned.

But it wasn't until 1927 when Hans B³abeck showed that the bulk of the written material had been concerned with the internal structure of settlement that a new area of study attracted considerable attention, i.e. the size, spacing and functions of Central Places.

It is now, more or less commonly accepted that every nucleated settlement, large or small, acts as a center for the distribution of goods and services to a complementary region. Since Christaller's ⁴classic study, numerous works have been published, some empirical, and some speculative, some confirming and some reflecting various principles postulated in his study. Central Places cannot exist by providing only for themselves, rather, they depend upon the support offered by a surrounding area. However, there are different degrees of support from , and relationships of the country to the urban center depending partially upon rural population density, income and social structures, transportation facilities, etc.

Certain centers have more centrally ⁵oriented functions than others and therefore they are of greater importance to their complementary region and consequently there are varying degrees of centrality, or importance. That this concept is not new, but rather a fundamental principle of Central Place Theory is generally accepted. However, differences occur over the question

3. H. Bobeck, "Grundfragen du Stadt Geographic", Geographischer Anzeiger, XXVIII, (1927), 213-14.
4. W. Christaller; Op. Cit.
5. Central functions are those goods and services produced and offered at some few points to be consumed at many scattered points.

of spatial distribution and more particularly over the concept of discrete levels of populations within the sub-classes of an hierarchy. Some ⁶ profess the absence of the hierarchy and advocate the Rank-Size Rule in which the centers are located along a continuum.

Although the Rule has been verified through empirical works, there is no reason to reject Central Place Theory as an inadequate explanation. Quite the contrary, neither can be displaced by the other and rather than being alternatives, they are compatible explanations at different class levels.

In the main, the focal point of all criticism against Central Place Theory appears to lie in the rigid constraints, (hexagonal trading areas, exacting distances, and the unrealistically equal distribution of resources over the land), proposed by Christaller. Thus, if a more flexible scheme which does not depend upon these limitations can be conceived, then the major criticisms will have been overcome.

Generally, we know that urbanization offered economic and other advantages (protection, social, etc.) that could not be acquired in a rural atmosphere to the same degree, that the majority of people in many parts of the world now live in settlements and that this rise of urban activity exploded rather recently. However, the present pattern of towns has taken place over a long time interval. In analyzing the spatial town patterns, Central Place Theory is primarily concerned with the optimum size of an area necessary to support towns and the efficient spacing of the settlements; the implication being that man makes some effort to organize his activities in an efficient manner.

6. R. Vining, "A Description of Certain Spatial Aspects of An Economic System", Economic Development and Cultural Change, III, (1955), 147-95

The main objective? - What is this best division of space -
i.e. how can the most people be the least distance from a center?

Some pertinent questions to be considered:

- a) Is there an hierarchy of settlements and activities as indicated by theory?
- b) Is the area rich or poor?
- c) What activities are supported?
- d) Did settlement occur rapidly or slowly?

If the constraints of Christaller's model were removed, there should be little argument against an hierarchic system of places. The resources of the land are not evenly distributed, nor is the surface of the Earth a flat tableland with uniform climatic conditions, such that economically advantageous regions are ^{so} caught in preference to those of lesser quality. A restriction of the hierarchy to hexagonal areas implies the presence of a static condition controlling the system, disregarding man's dynamic nature, subsequently that of his activities, and ultimately that of his creations. Thus we have no recourse but to perceive of any explanation of the sizes or spatial distributions of central places as one admitting a state of flux concomitant with the need of individuals to satisfy their needs in response to their economic capabilities.

Finally, the presence of several sites possessing the essential conditions for a new center suggests a random condition in lieu of a preconceived dispersal of the immigrants implicit in the symmetrical pattern projected by the rigid hexagonal scheme.

B. The Problem:

In this paper, I shall try to present sufficient evidence to establish the following:

1. a relationship between centers of the same size and those of the next lowest order.
2. a relationship between the functions of a center and its size.
3. that the Rank-Size Rule is not an alternate explanation.
4. that the size and spacing of central places are closely interrelated and that these centers are organized in a systematic manner, which does not necessarily imply symmetrical, as opposed to an indiscriminate scattering of centers over the landscape.
5. that the major constraints mentioned above, have been alleviated.

The most important implication arising from these relationships is that of an hierarchical classification of cities.¹ In this classification, each set of centers displays those functions which are characteristic to the centers lower than it in the hierarchy, yet possesses a new and different set of functions by which it distinguishes itself from those same centers. On the logical assumption that a greater number of functions demands a larger clientel to maintain a profitable position, then it should follow that each set of centers displaying its own discrete group of central place functions would similarly tend to possess a discrete population level.⁸ Christaller's determination to insist upon an hierarchy of central places at discrete population levels rather than consider a system of classes extending

7. B. Berry and W. Garrison, "The Functional Bases of the Central Place Hierarchy", Economic Geography, XXXIV, (1958), 145-54.
8. This statement arises directly from a discussion by Berry and Garrison on the "Multiplier Effect".
B. Berry and W. Garrison, "A Note on Central Place Theory and the Range of a Good", Economic Geography, XXXIV, (1958), 304-11.

along a continuum, has been the product of some of the greatest protests against his work. However, the most important factor, in restraining attempts to verify the validity of this concept, has been the lack of adequate statistical procedures, thereby giving way to speculation raising suspicion in the minds of many while causing others to dismiss it almost entirely.

Those functions occurring in the lowest order places are ^{that goods are} sold locally, ^{the towns} have relatively small trade areas and ^{that they} are supported by a correspondingly small population in their complementary region. Therefore, those higher order functions characteristic of higher order centers, ~~by necessity of their nature to be~~ supported by a prolific population, encompass much more extensive tributary areas than lower order places and as such, the centers must be located further apart from each other. In view of the closely bound relationships of the location and size of central places with the functions of those places, most of the studies concerned herein will be those considering the hierarchical classification of central places.

There are three main sections to the paper: the first deals with three theoretical works accompanied by an analysis of their similarities and differences; the second dissects the original work of Christaller into concepts and attempts to justify their relevance and significance; the third section outlines a suggestion for research study in the concept of a center's importance in relation to the extent of its use by the surrounding population.

C. Analytical Studies:

I. Walter Christaller⁹

The theoretical framework for establishing the limitations of Central Place Theory has come from Walter Christaller. Every urban settlement, irregardless of size, is in some degree the focal point of finance, trade, commerce, administration, etc. The essence of the theory is that a certain amount of productive land supports an urban center.¹⁰ "Cities do not grow up of themselves, contrysides set them up to do the tasks that must be performed in central places."¹¹ This is thought to be the first time that the term Central Place was used for the specific purpose of denoting the nucleus for a variety of human activities. These activities, or "functions" as they shall be referred to, vary in number and complexity with the size of the central place.

That region for which a central place is the center is called a complimentary region and is very difficult to determine because its size varies with the commodities offered at the center - and each has its own particular range. Even the range of a specific good is constantly fluctuating due to a variety of factors, e.g.- the price might be higher or lower than the same good at another center, population density, distribution of both the urban concentration and the surrounding area, incomes, social structure, etc. But if an individual can purchase a given commodity at only one of two centers, the place which offers this good will attract more business since the

9. Op. Cit. (see page 2)

10. E. Uelman, "A Theory of Location For Cities", American Journal of Sociology, XLVII, (May, 1941) 835-64.

11. M. Jefferson, "The Distribution of the World's City Folk", Geographical Review, XXI, (1931), 453.

individual, already having expended the time-journey-cost factor, will probably conduct the remainder of his business at the same center rather than make an extra trip to the other place which might be even closer.

Centrality, being concerned with the importance of a place, deals more with the functions of a place than the spatial central location. However, the two are intimately related for in order to function most efficiently, the place should be located so that it is central to the maximum profit area it can command in relation to the population distribution.

The range of a good includes all those variables previously mentioned plus the additional factor of economic distance - i.e. the farthest distance one is willing to travel in order to obtain a particular commodity. The term used is economic distance - the geographic distance converted into freight and other economically important transportation advantages or disadvantages - or, converted into monetary terms. Essentially, there are two limits to be considered in the offering of any central good. The inner limit establishes the minimum number of units to be consumed before the offering of the good will be profitable. The outer limit establishes the farthest possible market area for this good, beyond which the cost of purchasing the item will be too great for the individual.

In Christaller's system, the basic function of a city is to be a central place providing goods and services for a surrounding complimentary region, the centrality of which determines the degree to which it is a service center. Higher order places offer more goods, have more establishments, more business functions, larger populations and tributary areas, do greater

volumes of business and are more widely spaced than lower order centers. *Christaller* noted 9 sub-sets in his classification (highest to lowest).

- R - Reichshauptstadte
- Rt- Reichsteilstadt
- L - Landeszentralen (Regional Capital City)
- P - Provinzialhauptorte (Provincial Head City)
- G - Gaubezirk (Small State Capital)
- B - Bezirkhauptorte (District City)
- K - Kreisstadtchen (County Seat)
- A - Amtsstadtchen (Township Center)
- M - Marktflecken (Market Hamlet)

In setting up his scheme (Fig.1), (a) *Christaller* placed dots on a sheet of paper such that all dots were equidistant one from the other and represented the lowest order places: i.e. M-places. His second step (b) was to mark near the center of the diagram a circle around a dot then do the same to each dot that represented a corner to the next largest triangle. These dots represented A-places.

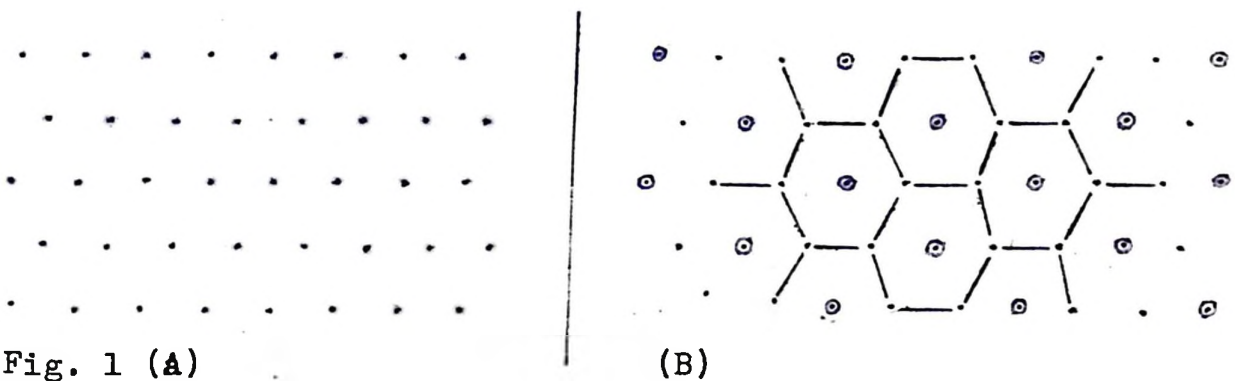


Fig. 1 (A)

(B)

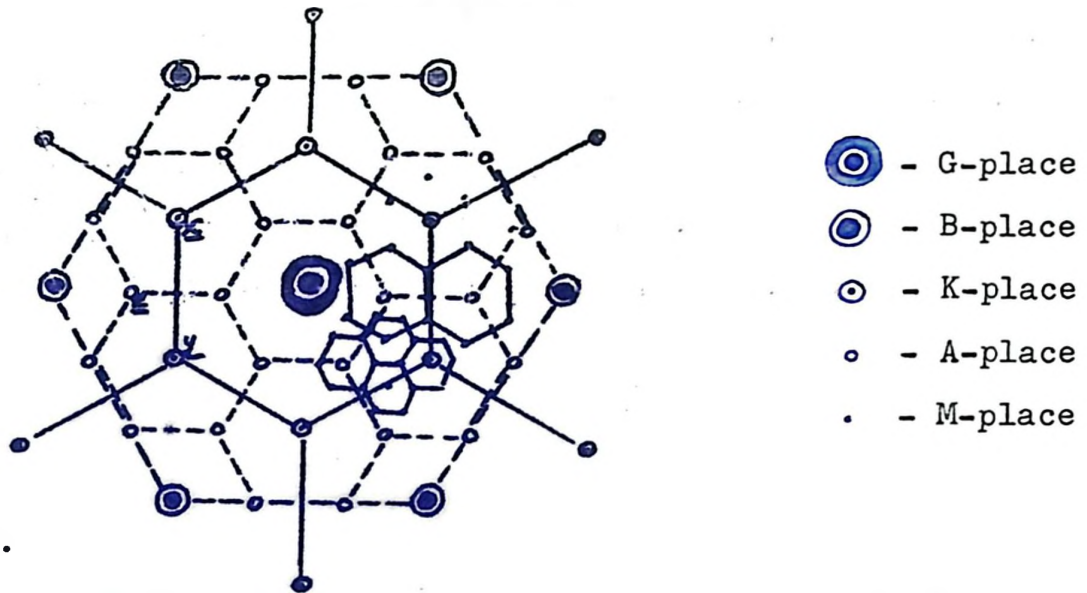


Fig. 2.

In Fig. 2 let us assume that the central places X, Y and Z, all being primarily, **A**-places in importance are at a distance of d_1 units apart, thereby giving rise to a market range of $\frac{d_1}{2}$ units for the goods and services. However, places X and Y are also **K**-places so that their distance will be determined according to $(\sqrt{3} \times d_1)$ and the range will be $(\frac{d_1 \sqrt{3}}{2})$. Ultimately, each higher order center in the class system will be surrounded by six centers of the immediately lower area, each of which represents one corner of the encompassing hexagon. Following this principle, the centers of each correspondingly higher subset will increase by the $\sqrt{3}$ over the next lower order center: i.e. **B**-places will be $(\sqrt{3})^2 \times d_1$

$$\text{B-places will be } (\sqrt{3})^3 \times d_1$$

Considering a normal time-distance ratio of walking to be 4 Km. per hour, the distance assigned between M-places was $4\sqrt{3}$ or 7 Km. Christaller also recognized the frequency of settlement occurring from the largest to the smallest center as: 1: 2: 6: 18:

The most logical shape for a complimentary region would be of the Thünen Type ¹² and circular in nature. Christaller though, rejected this pattern in preference of the hexagon due

to the inability of circles, even when placed so close together that their circumscribed areas are tangential to each other, to accommodate the whole region thereby leaving some of the areas unserved. (see Fig. 3)

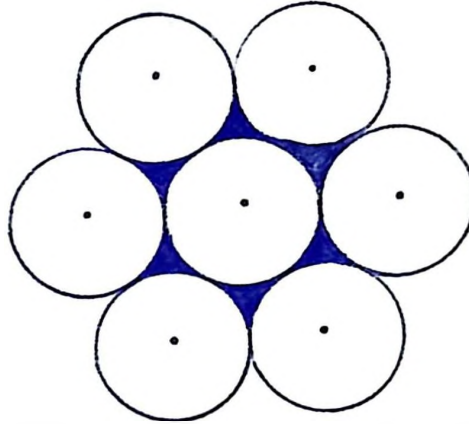


Fig. 3: Circles leave unserved areas: e.g. the darkened areas, Hexagons do not.

According to Christaller's theory, low order centers provide only low order goods to low order tributary areas. These goods are usually necessities requiring frequent purchasing with little consumer travel and are provided by establishments with relatively low conditions of entry. Higher order goods are purchased in establishments with greater conditions of entry and usually constitute, "shopping goods", for which the consumer is willing to travel longer distances, but less frequently.

II. August Lösch:¹³

Since Christaller, the idea of hexagonal trading areas was adopted by August Lösch in his creation of a complete economic landscape based upon the concept of an hierarchical classification. As did Christaller, Lösch assumed a regular

12. J. von Thünen, "Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie", Rostock, (k826); M. Chisholm, Rural Settlement and Land Use, Hutchinson University Library, Chapter II.

13. A. Lösch, "The Nature of the Economic Region", Southern Economic Journal, V, (1938), 73.

dispersal of economic and land production factors throughout a featureless plain. A further assumption was the regular distribution of the population and self-sufficient farmyards. If a farmer decides to produce and sell a commodity for which he has produced a surplus, he will at the same time be helped by economies of large scale production and hampered by increased transportation costs. The demand curve for a particular commodity is shown in Fig. 4. The quantity demanded at the point of production = Q . Whereas the demand decreases with increased transport costs as shown first at P_1 where the demand is Q_1 and finally at P_2 where total costs = total revenue, further shipments would result in a loss OP at which point the product becomes too expensive for the consumers and they seek out an alternative location or a substitute article.

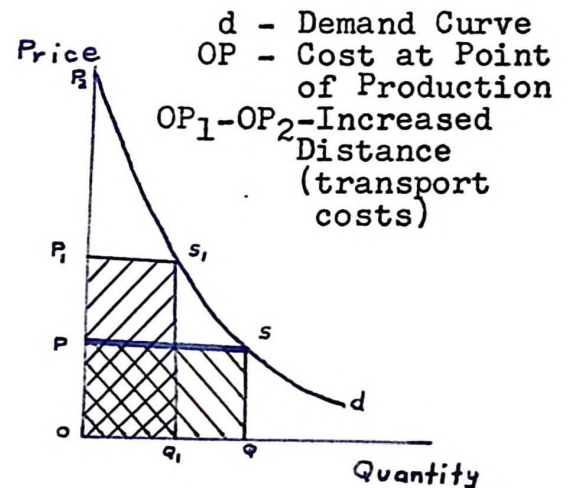


Fig. 4

To illustrate the effect of other prices, Lösch considered the demand curve, as a function of the price at the point of production; and the planning curve defining the limits of the minimum costs of production per given output. If the planning curve is to the left of the demand curve, then the producer will experience excess profits (Fig. 5A). Now, says Lösch, if such a situation prevails, another producer will move into the area to attract these excess profits so that the planning curve is now tangential to the demand curve; i.e. the presence of two supplying agencies now decreases the sales of

the original supplier, and no excess profits are available. ¹⁴

(Fig. 5B)

Assuming several different products, the trade areas of these take on the appearance of nets of hexagons and are spread over the plain in a manner such that they all have one center of production in common. These nets are then rotated until a minimum number of producing centers serving the entire plain are encountered.

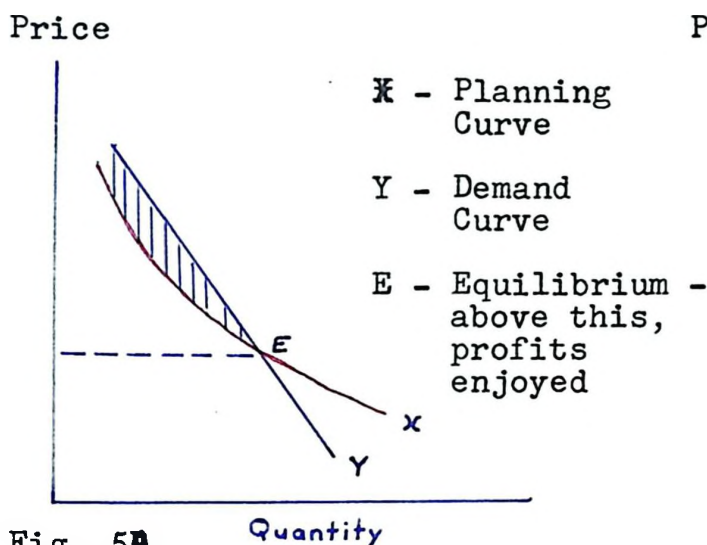


Fig. 5A

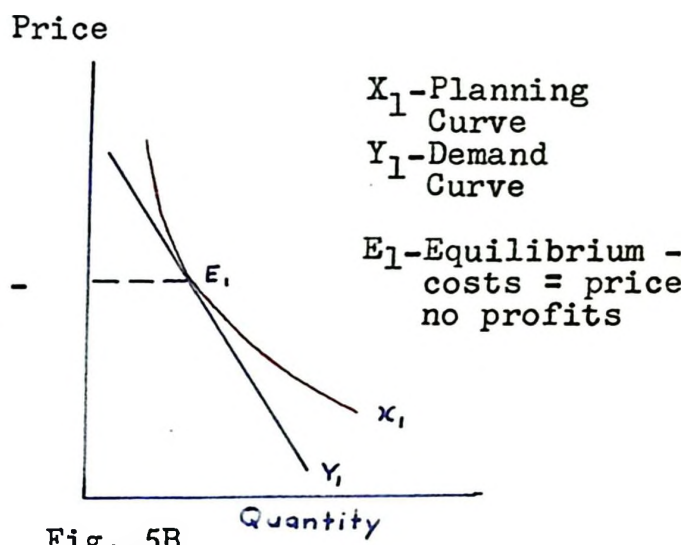


Fig. 5B

The optimum combination of the entire set of feasible combinations he referred to as "an economic landscape", characterised by six densely and six sparsely developed sectors radiating out from the common center. It was also determined that places performing the same number of functions do not necessarily provide the same types of functions.

It was decided too, that the ideal situation was most readily approached in thinly settled rural districts displaying a minimum amount of industrial activity over a relatively uniform landscape.

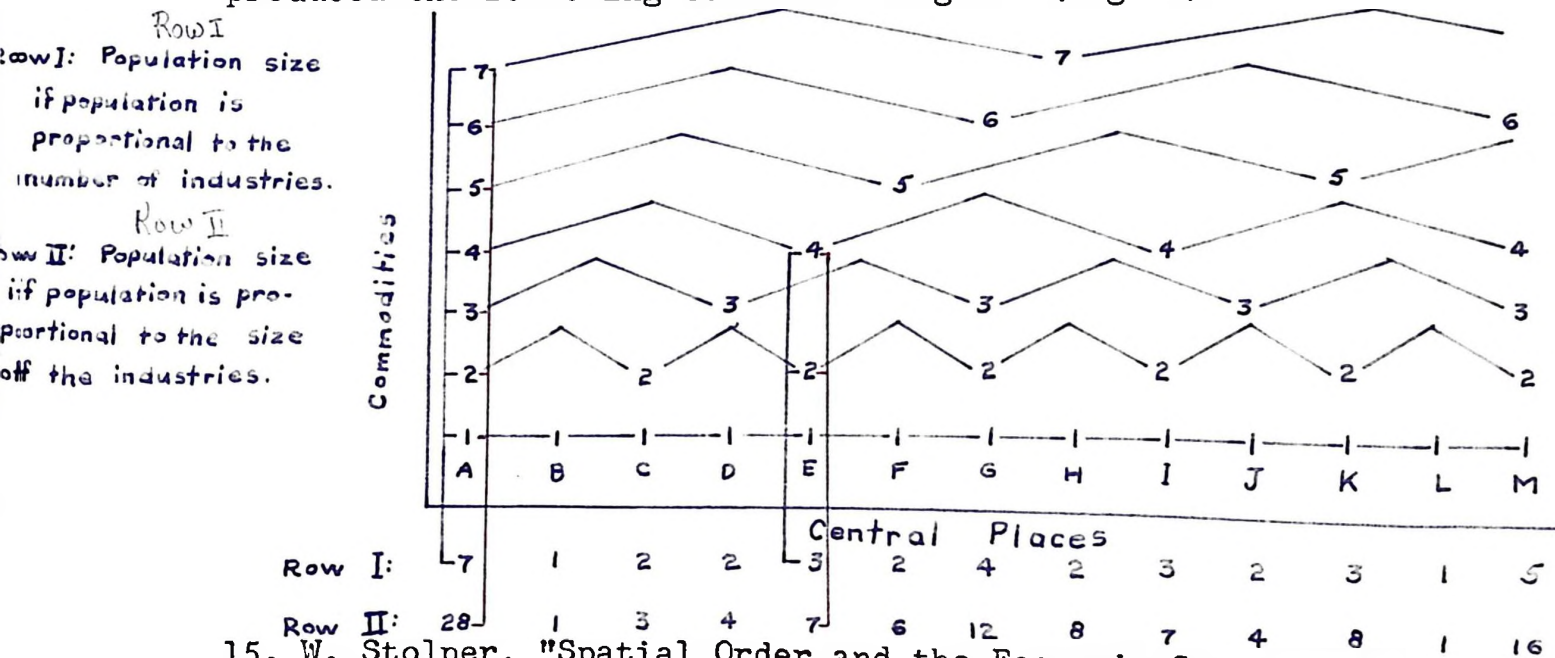
14. Berry and Garrison provide evidence that excess profits do exist. Berry and Garrison, "A Note on Central Place Theory and Range of a Good", Economic Geography, XXXIV, (1958) 145-54.

III. Wolfgang Stolper¹⁵:

As did Christaller and L^ösch, Stolper assumes the criteria of evenly distributed factors of land resources such that each producer will draw customers from the neighbourhood until the good becomes too expensive to purchase at which point another or several other producing agencies will be erected to supply and live off of the unserved hinterland. In the Christaller and L^ösch models, the networks of individual goods and services produced are rotated until a maximum number of producing centers coincide such that the transport costs are reduced to a minimum. The most important implications of these two systems are:

- (i) Different goods have different sized market areas
- (ii) Every consumer lies within the market area of every good
- (iii) Both give rise to a system of cities

Stolper, in an effort to show these implications produced the following schematic diagram. (Fig. 6)



15. W. Stolper, "Spatial Order and the Economic Growth of Cities," Economic Development and Cultural Change, (1955), 137-146.

In the diagram, Stolper assumes Good 1 to be a local good, e.g. - a haircut, therefore, it is produced everywhere and has a small sales radius. Good 2, 3...7 become progressively more specialized than the good before it in the hierarchy such that the sales radius increases and it skips a central place location. If this assumption is accepted, then the model illustrates:

- (i) Small centers are more numerous than large centers.
- (ii) Large centers are farther apart from each other than are small centers from each other.
- (iii) Centers of the same size do not necessarily produce the same goods. e.g. Center C produces Goods 1 and 2 while Center H produces Goods 1 and 7 (if population is proportional to the number of industries - i.e. look across line = Roman Numeral I) OR Center H produces goods 1 and 7 while Center K produces Goods 1, 2 and 5 (if population is proportional to the size of the industry - i.e. look across line = Roman Numeral II). Conversely, the same goods may be produced in towns of different sizes.
- (iv) There is no validity to the statement that the largest industries necessarily congregate in the largest centers.
- (v) Each farmer is clearly within the market area of every good either indirectly in his nearest town or directly by going to the larger center.

Even though the three models referred to are theoretical in nature they arrive at basically similar conclusions concerning a system of centers in regards to size and location. What differences are there?

Theoretical differences, as well as similarities, exist among these three works:

1). Primarily, there was Christaller's preoccupation with service activities and market-oriented products while L^ösch gave top priority to the consideration of production possibilities of manufacturing firms. Stolper considered

both activities in his model.

2). Nor did Stolper make any reference to particular trade area shapes or distances whereas Christaller and Lössch both emphasized the hexagonal area as being the most ideal. Christaller continued by tagging each classification of places with specific inter-center distances ($d_1\sqrt{3}$); Lössch asserted that at the point where total costs = total revenue, the division line between two centers of equivalent influence, would be drawn.

3). A system of central places developed upon the basis of range of central goods used the assumption that all areas were able to be served from a minimum of central places, therefore the principle upon which the system was developed can be called the Marketing or Supply Principle. Christaller considered two other principles as well. According to the Traffic Principle, the distribution of central places is at an optimum where as many important places as possible lie on one traffic route between larger towns, the route being established as cheaply as possible. Complementary regions then "nest", according to a rule of 4's (Fig. 7B) as opposed to the Marketing Principle where nesting occurs in 3's (Fig. 7A). Principles of traffic are fundamentally linear. The Administrative Principle (Political-Social), is based upon the idea of separation of complementary regions for purposes of protection, or of distinction which implies clear-cut administrative control - nesting occurs in accordance with a rule of 7's (Fig. 7C).

One extension of Christaller's notions of the arrangement of central places was that of Lösch concerning the special cases of networks to include a more general description of a system containing all possible relationships of evenly spaced places and nests of hexagonal shapes of complementary regions.

4) As already noted, Lösch suggested the idea of no excess profits. Christaller made no such stipulation: e.g.- "if a doctor must have at least 2,667 consultations a year in order to exist and can make no more than 8,000 consultations, then



Fig. 7A

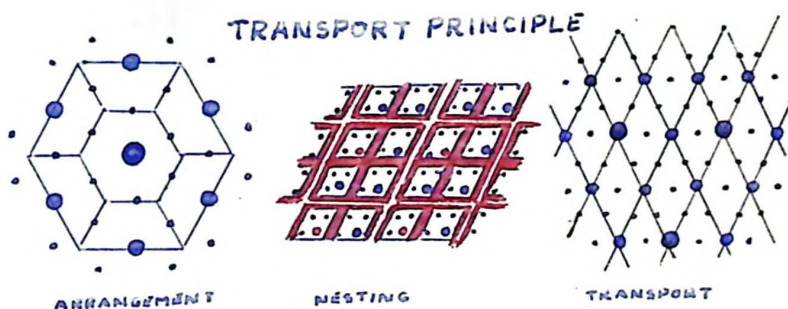


Fig. 7B

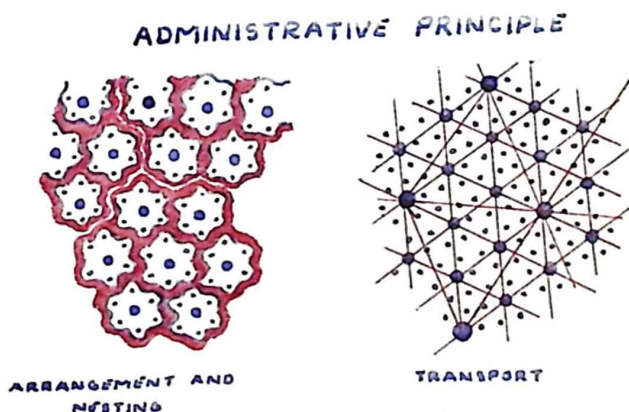


Fig. 7C

obviously, any number of consultations between 2,667 and 8,000 is representative of his excess profits. This variation has occurred through different definitions of the term range. In Christaller's classification anything beyond the inner limit is considered excess profits out to the outer range, but in that of Lösch, the limits of the trade area coincided with the point where total revenue = total costs.

5) The deviations occurring in the ideal spatial arrangement for the individual commodities is not as great in the Löschian system as the Christalleran, due largely, to the greater number of possible sizes of complementary regions:

Lösch - 1, 3, 4, 7, 9, 12, 13 (Fig. 8)

Christaller - 1, 3, 9, 27, 81

In Fig. 8, the numbers in parentheses indicate the commodities produced at the respective places. Numbers not in parentheses indicate alternate choices for that good but that the good is not produced at that location: - e.g. (4) = the site of production while, 4 = the alternate site. When alternatives such as this occur for a particular good, then it is usually located at that point closest to other producers due to agglomeration preferences. Thus, section I is the sparsely developed area and Section II

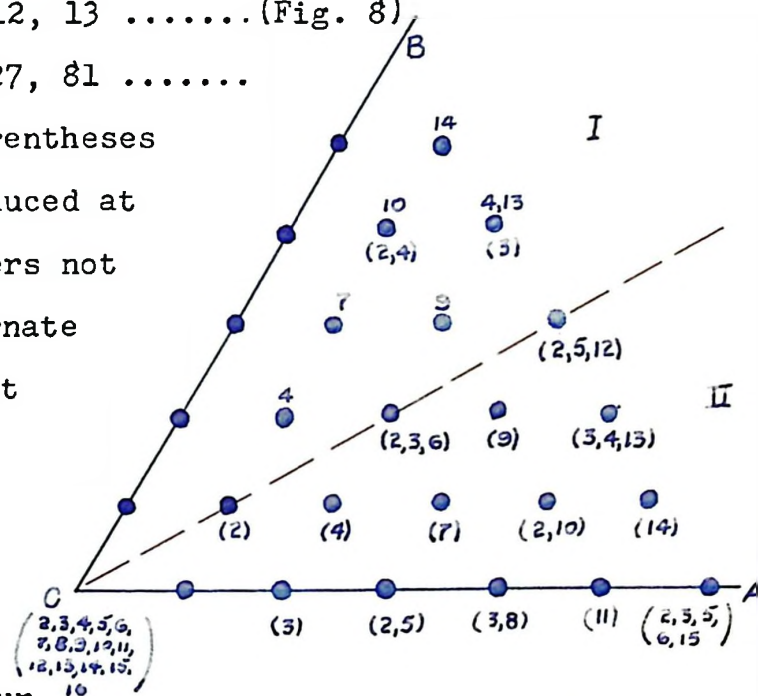


Fig. 8. A portion of a 60° sector. One sparsely and one densely developed area. All sectors are symmetrical, therefore, this is representative of all the others - See Fig. 9.

represents the densely developed region.

6) There is also a difference in the beginning procedures used by L^ösch and Christaller. The former begins at the bottom of his classes with the lowest center and then introduces the next largest market area as a higher order good is summoned.

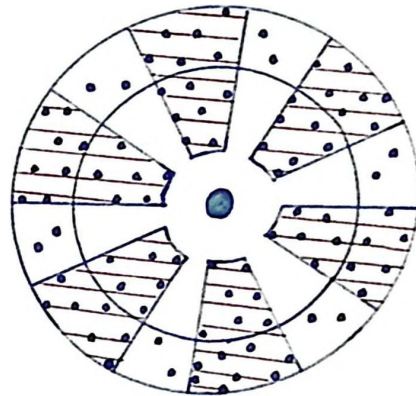


Fig. 9: An illustration of L^ösch's 6 densely and 6 sparsely populated areas.

Christaller, starts at the top of his hierarchy with the largest center, optimally located, and works down with successively lower ^{order} ~~other~~ goods and their respectively smaller centers.

7). Whereas Christaller tended to associate certain groups of activities with centers at a particular class level in his system, neither Stolper nor L^ösch agreed. Both presented opinions to the contrary and tried to show that places of similar sizes did not necessarily exhibit the same functional complexity. At the same time, Christaller proposed that each higher order central place supplied or produced all of these commodities of lower order centers.

8). Finally, Christaller's system is simpler and therefore easier to test than that of L^ösch. Individual ranges are disregarded and a whole complex of activities associated with the classes, whereas the L^öschian system must take particular account of each individual commodity.

It should be kept in mind though, that the theories of Christaller and L^ösch were considering the activities of

two differently oriented population groups; the former investigated an agricultural setting, while the latter expended his efforts in an industrial landscape. Thus, differences are to be expected in criteria and techniques, but these do not overshadow the primary investigation of possible relationships between sizes and distances of centers.

D. CONCEPTS AND EMPIRICAL WORKS:

I. Central Place:

In Christaller's system, one does not find the definition of central place by looking at the appearance of a town - rather, only by looking at the particular characteristic allowing it to be called a town, i.e. its ability to serve as the center of a region. Region may be used in its broader sense to refer to a large center which acts as a retail distribution center for smaller centers (New York) or in the more restricted sense of a hamlet or village which exists solely for the service of a rural dispersed population. It is of considerable significance that we remember the limits set by this definition, in order to minimize confusion presented by other works which have attempted to criticize the whole of Central Place Theory.

Historically, fairs and markets presented the location and opportunity for merchants to display their merchandise and effect a sale. These merchants followed a fairly regular cycle and well established circuit in conducting their trade in order to secure for themselves a greater assurance of a substantial local turnout. In the pre-industrial age, the great majority depended upon their rural surroundings for

supplies of food, and were firmly rooted in the agricultural life of the countryside,¹⁶ "but in the last hundred years, industries have caused some to grow upon the countryside without any organic relation to it".¹⁷ The validity of this statement was never questioned at any point in Christaller's study since he was more concerned with the spatial distribution of, and the activities performed for the tributary areas of agricultural or rural centers. Actually, Christaller even left a place open for larger complexes in his system, i.e. the higher order centers in his system such as Munich and Stuttgart. When considering the wholesale and retail activities of the metropolitan areas in the United States, Siddall¹⁸ found that all of the centers that were outside of the North Eastern manufacturing belt, except two (Miami and San Diego), exhibited a high index of centrality (yet all areas under study were greater than 500,000 population). He explained the low centrality factor of both Miami and San Diego to poor locations for serving a large hinterland: San Diego was restricted by the sea on one side and an international border on the other, while Miami's hinterland was restricted also by the ocean. Further, both were resort towns and drew their support from a national level.

16. A. Smailes, *The Geography of Towns*, Hutchinsons University Library (1953), 135.
17. R. Dickinson, *City and Region*, Routledge & Kegan, London, (1964), 87.
A. Smailes, Op. Cit.
18. W. Siddall, "Wholesale-Retail Trade Ratios As Indexes of Urban Centrality", Economic Geography, XXXVII, (1961), 124-32.

Further, in regard to the above statement by Smailes and Dickinson, there are many countries still to-day that have as their primary economic base, agricultural activity. Even in England and more particularly the United States, large portions of the country are used for working the land. On the contrary, it would appear that industrialized sectors of a country are restricted to local pockets so that to brush off Central Place Theory as an inadequate approach would at this time be the paramount ^{of} error. This is not to say that we must not give careful consideration to the theories of industrial location. We must recognize the differing conditions and limitations underlying the potential prosperity of both activities. Simply stated, the main difference is that agriculture is an areal pursuit while industry is built up on a relatively concentrated area.¹⁹ It was further observed by Ullman,²⁰ that "In highly industrialized areas the central place scheme is generally so distorted by industrial concentration in response to resources and transportation that it may be said to have little significance as an explanation for urban location and distribution, although some features of a central place scheme may be present as in the case of Cologne and the Ruhr."

In this perspective, it is not difficult to see that while all centers will display some functions engaged

19. W. Stolper, Op. Cit.

20. E. Ullman, "A Theory of Location For Cities", American Journal of Sociology, XLVI, (May, 1941), 858.

in collection, servicing and distribution activities for their immediate complementary region, the degree of concentration varies from place to place. At the one extreme, are those places which will be supported almost entirely by their complementary region while at the other extreme will be those centers which have very little connection with their complementary region.

Ullman and Harris²¹ have done considerable work in this field and have come to recognize three types of cities:

a) The specialized city is one in which a special function is carried on, usually a particular resource of some sort (mineral, resort, etc.):- Fig. 10A.

b) Transport cities are those performing break of bulk activities along transport routes:- Fig. 10B.

c) Central Place Cities are those cities which exist to serve as centers for the surrounding area. Their future is dependent upon the productivity of the soil and they are usually evenly spaced:- Fig. 10C.

The authors note that most cities represent a combination of these factors such that the relative importance of any one varies from city to city.

21. D. Harris and E. Ullman, "The Nature of Cities," Annals of the American Academy of Political and Social Science, CCXLII, (Nov. 1945), 7-17.

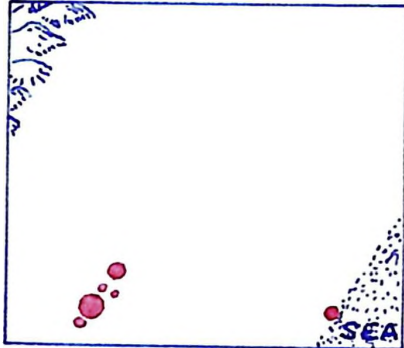


Fig.10A - Specialized function settlement. Large center is manufacturing and mining town surrounded by smaller settlements on the mineral deposits. Small centers on shore and at the foot of the mountain are resorts.

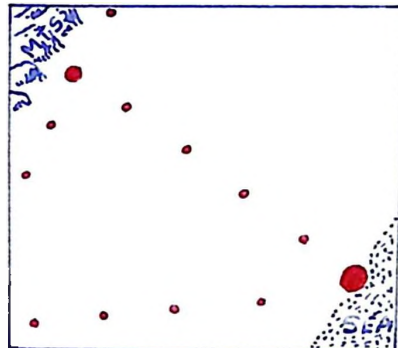


Fig. 10B - Transport centers are aligned here along the railroad or at the coast. Large center is a port, next largest is a railway junction and engine-changing point where mountain and plain meet.

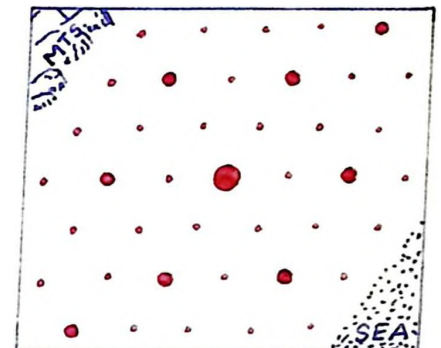


Fig.10C - Theoretical distribution of central places:- homogeneous plain and evenly spaced centers. Largest city is in the center surrounded by 6 medium size centers and each of these by 6 small centers. Tributary areas are hexagons.

In summary, two main points should be kept in mind.

A central place exists, primarily to perform those functions (collection, distribution, servicing, administration, social, etc.) demanded by the supporting complementary region. Therefore, a place which imports raw materials and/or exports the finished product outside of the local region, is not considered to be basically a central place. Secondly, central places vary according to size depending upon the size of the complementary region. Small centers perform only simple functions for the immediate consumer demand while large centers perform more complex functions and cater to a much larger trade area.

II. CENTRALITY

Defined as importance, centrality became the basic criterion of Christaller's study. He conceived of a place's importance not in terms of a numerical value such as the population size of the place, but rather as the surplus of importance of the place itself; i.e. " $B-B_z$ "

where B = the aggregate importance of the area (absolute importance)

B_z = the importance of the central place.

As mentioned above, the chief function of a central place is to act as a center for the surrounding population, not its own. This index of importance, he defined as centrality; a representation of the amount of activity carried on beyond the center itself with its tributary region. Through this relative importance of a place in relation to its region, centrality gave rise to various sizes of central places.

With the importance of a center defined as such, Central Place Theory shapes up as a partial study only, considering service activities and market-oriented products while omitting the causes and influences of the spatial arrangement of industrial activities. Berry²² and von Barenter²³ are two investigators who have alluded to this fact.

22. "Rather than being a general theory for cities, Central Place Theory is a theory of location of tertiary activity". - B. Berry and A. Pred, "Central Place Studies: A Bibliography of Theory and Application", Regional Science Research Institute, (1961).
23. The location of primary and secondary industries are determined by raw materials, traffic routes and historical accidents which have led to the growth of certain centers of demand and thus attracted new industry and service activity. The latter may be spatially distributed according to some hierarchic scheme within the agricultural and manufacturing sectors, and oriented according to traffic routes:- E. von Barenter, "Spatial Organization Theory as a Basis For Regional Planning," Journal of American Institute of Planning, XXX, (May, 1964), 90-99.

In order to develop a quantitative method of investigation, Christaller chose as his measure of centrality, the use of telephones, assessing this to be the most reliable relationship between centers. His formula was: $Z_z = T_z - \left(E_z \cdot \frac{T_g}{E_g} \right)$ where:

Z_z is the centrality of a place

T_z is the number of telephones

E_z is the number of inhabitants

T_g is the number of telephones in the area served by it.

E_g is the number of inhabitants in the area served by it.

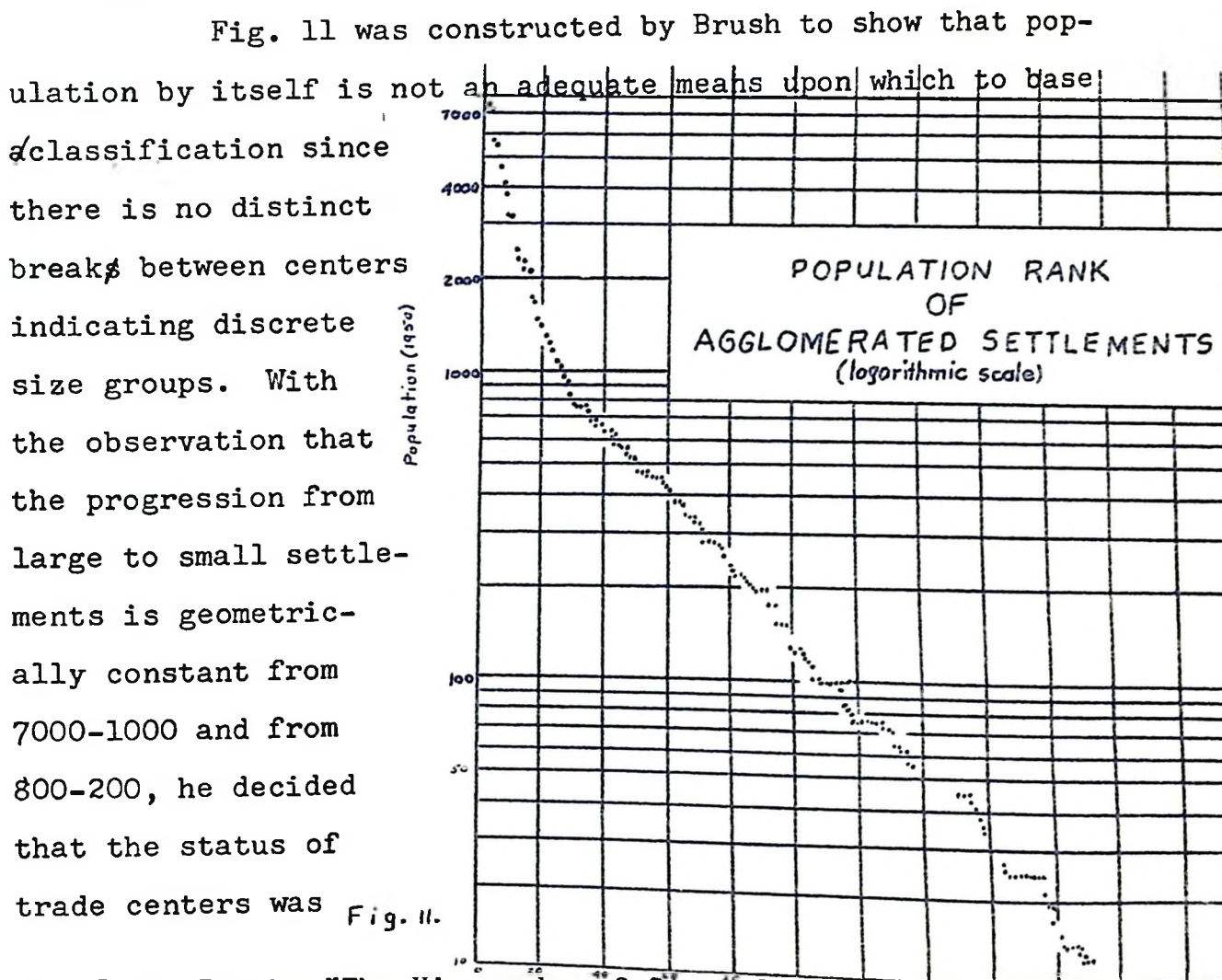
∴ Centrality (Z_z) is the difference between the actual importance, (T_z) and the importance of what a center should be in proportion to its population $\left(E_z \cdot \frac{T_g}{E_g} \right)$.

At the time of writing his paper, this may have been an adequate means of determining centrality since supply and a high cost factor possibly limited the use of phones to business establishments. However, it would be out of the question today since there are more telephones installed in residential and public places than are used by business.

On the basis of the results obtained from the use of the above expression, Christaller proceeded to classify his centers according to a specific set of functions common to each subset in the hierarchy. This, accompanied by specific distances between the various orders of places and the stringent concept of hexagonal trading areas, have caused considerable dissatisfaction with the theory - the ideals postulated were too out of contact with reality.

More recently, other methods have been used to determine centrality. A study carried out in Southwestern

Wisconsin²⁴ was based on an assessment of the number and kind of central functions in the center. Specifically, the approach embodies the classification of centers according to the degree to which each is supported by the following functions: banks, retail and wholesale establishments, commercial, professional, administrative and financial offices and social institutions. Previously, this method had been used by Dickinson²⁵ who found that certain functions tend to agglomerate at different population levels such that grades of urban settlement would be recognized.



- 24. J. E. Brush, "The Hierarchy of Central Places in Southwestern Wisconsin", *Geographical Review*, XLIII, (1953), 380-402.
- 25. R. Dickinson, *City and Region*, Routledge and Kegan, (1964), 77.

to be found by investigating the combinations of functions performed, and set up a classification of three types; hamlets, villages and towns.

Unfortunately, Brush considered only single cities rather than groups of cities, correlated with population rank in lieu of groups of functions. This inadequacy led to a sharp rebuttal by Vining,²⁶ in which he charged Brush's method as being strictly arbitrary in nature, discredited the concept of an hierarchic system of discrete population levels, proposed the Rank-Size Rule as a more satisfactory explanation, and postulated the concept of size distribution along a continuum. This shall be considered later under, "Rank-Size Rule", (Page 55).

In any event Brush's study proved to be one of the best known empirical works and stimulated further studies.

At the same time Brush was conducting his study in the United States, Bracey²⁷ was performing a similar survey in England. His information was obtained from questionnaires which were sent to each village and hamlet and asked which town or village was visited for each of four different services: (medical supplies and services, shopping, business professions, entertainment). The method of scoring, allowed one point for each of the services if the place was visited for that service; if more than one center was patronized for the same service, the point was shared equally between the two centers. The total points were representative of the rural component of centrality for each of the towns.

26. R. Vining, "A Description of Certain Spatial Aspects of an Economic System, "Economic Development and Cultural Change, III, (1955), 167-69.
27. H. Bracey, "Towns as Rural Service Centers: An Index of Centrality with Special Reference to Somerset," Trans. and Papers of the Inst. of Brit. Geogr., No.19, (1953), 95-105.

The greatest defect in this method, is the allocation of points for each of the services, (one point); no attempt was made to distinguish the difference in the relative importance of each of the variables in the questionnaire. As such the method fails to produce a sufficient measure of the relationship between the importance of the center and that group of activities which is predominantly responsible for the center's status within the hierarchy at that time. On the other hand, Brush listed those activities which occurred with the greatest frequency in his system of classes; thus, one can visualize an increase in number and specialization in each of the functional classes. e.g. Retail Trade - (1) Hamlet - General Store

(2) Village - 7 functions

(3) Town - 10 functions including jeweller, florist, drugstore.

Another unfortunate aspect of Bracey's questionnaire method was his choice of people to be interviewed. Basically, they were the more prominent type of citizen, casting some doubt onto their ability to objectively reflect the actual trade patterns and habits of the inhabitants in the center being surveyed.

One further point of criticism involves the manner by which trade areas were assigned to one town or the other. If a service village (lowest class) on the basis of its activity, was assigned as a trade area for Village A, and this village in turn was assigned to the trade area of Town B, then all of this area would be included as a portion of Town A's complementary region, even if the service village happened to be closer to a different town.



Fig. 12.

In Fig. 12, the service center is definitely within the trade radius of Village A, while Village A is closer to Town A than Town B. Therefore, according to the system, Village A being associated with Town A automatically implicates its trade area which extends over the service center and the latter is represented as such in the illustration presented by Bracey.

More accurate results could have been obtained through the use of a more universal approach in the sampling technique in an effort to assess a more precise representation of the habits and patterns practiced in each of the communities investigated, as well as a better method of weighting the services according to the frequency with which they are purchased.

Another criterion suggested as a possible ^{for} measuring centrality was the per capita wholesale sales for cities in the United States.²⁸ Underlying this argument, however, is the gross assumption that there is no significant difference from one city to another or from one region to another in the total retail purchases per person. But, the number of sales conducted depends upon the purchasing power of the individual in the city and it would certainly seem quite naive to assume no such variation existed between citizens in the cities of Hamilton,

28. R. Dickinson, "The Metropolitan Regions of the United States," Geographical Review, XXIV, (1934), 278-91.

Ontario, and Halifax, Nova Scotia; or within the Niagara Economic Region between St. Catharines and Brantford.

Other research methods employed consider variables such as traffic flows, newspaper circulation and bus routes (~~methodology is examined under "Range of a Good"~~) proportionately to the center's population.

The most sophisticated study of all is probably that of Berry and Garrison²⁹ in Snohomish County, Washington. Centrality, being concerned with functions of a place, induced the researchers to investigate and produce an empirical piece of work on the relationship between the functions and population of small centers. The basic aim of their paper was to establish an hierarchy of discrete populations levels from the relationships obtained and therefore I have included this in a subsequent section ("Size of Central Places"). The point that I wish to express through reference to this work is that in their final analysis, with the establishment of a three class hierarchy, they have provided an indirect means of determining an index of Multiple Centrality. (Multiple in that groups of centers are associated - not the singular, isolated occurrence of a center).

Centrality in Central Place Theory, is defined as the excess of importance of a center after subtracting its own importance from its total importance. With a few modifications, Bracey's technique should be a more than adequate means of assessing centrality.

29. B. Berry and W. Garrison, "The Functional Bases of the Central Place Theory", Economic Geography, XXXIV, (April, 1958), 145-54.

III. RANGE OF A GOOD:

The expression, "Range of a Good", is to be considered as the distance that a dispersed population is willing to travel in order to purchase a given commodity. Some items are necessities such as food and therefore require frequent purchasing. At the same time, many of these products are perishable goods which cannot stand long hauls or lengthy storage periods. Other commodities are less frequently purchased, some could be classed as luxuries and therefore the demand will be less. Quite clearly, the first group of shopping goods or primary requirements³⁰ demand local outlets which are reasonably close at hand to economize on travelling time and expenses. These goods, called "low order goods",³¹ are accompanied by low conditions of entry and have short ranges. The secondary requirements of a more specialized nature are noncommittal with high conditions of entry, demand a greater clientele and of necessity dominate a larger sales radius.

Duncan³² has questioned this idea of specialization. Specifically, he states that the conditions of life in the large cities generate certain needs which are dependent upon a heavy local demand and that as the city increases in size, certain services performed by the householder or businessman for themselves, are demanded in sufficient quantity to support special-

30. M. Williams, "A Note on the Influence of Adelaide on Rural Shopping Habits in Counties Frome, Dalhousie and Victoria, S.A.", The Australian Geographer, IX, (Mar. 1965), 312-14. Williams uses the terms Primary and Secondary Requirements.
31. W. Christaller, Op. Cit.
32. O. Duncan, "Service Industries and the Urban Hierarchy," Papers and Proceedings of the Regional Science Association, V, (1959), 105-19.

ized units supplying them rather than requiring a non-local market area.

That these statements by Duncan are true is surely self-evident, but that they are at odds with Central Place Theory is not. Central Place Theory stipulates that, "every consumer has access to every good that is produced; every consumer lies within the market area of every good"³³. This does not mean that every individual will have need of, or even support every commodity, rather, the production of goods and services is so distributed over the entire area that the individual has easy access to commodities within his limits and preferences.

Further, implicit within the scope of Central Place Theory is the center's role as distributor not only for the complementary region but also for its own inhabitants. With a greater concentration of purchasing power, service industries are left free to break away from the more generalized units and become independent specialty centers. As a Central Place assumes greater importance and expands, the service industries do the same. Some merely expand their floor space and acquire greater volumes of goods, e.g. department stores; while others, due to convenience must establish new units, e.g. - gasoline stations (i.e. duplicate facilities) while still others disintegrate into distinct specializing functions, e.g. - brake repair, transmission service. Thus, an individual who visits the larger central place for one or another of these reasons will probably conduct the rest of his business, such as regular shopping, at this same center. The greatest asset of these functions is their ability to act as a "drawing card".

33. W. Stolper, "Spatial Order and the Economic Growth of Cities" Economic Development and Cultural Change, (1955), 137-46.

This idea that there was an increasing number of items necessary in a place to induce a customer to shop at a given store at a greater distance was also suggested by Baumal and Ide³⁴ in a study of retail activities. Evidences to support this suggestion come from Mayfield³⁵ and Williams³⁶. The former, found in India that a rational choice by the consumer had been made in terms of minimizing travel inputs. A high positive correlation was found between an increase in distance to alternative centers and an increase in the number of items necessary at that central place. Williams found that for general necessities, individuals patronized the nearest local center. But for the other items (clothing, shoes, furniture, solicitors, medical service, etc.) the people travelled to the larger center of Adelaide.

Because of the differences in the optimal sizes of a good's range, a complex system of networks of markets evolves,³⁷ such that certain goods will be offered in every second, third or fifth central place, thus lending some credence to the suggestions of W. Stolper (page 15).

Transportation is another variable exacting a considerable degree of influence upon the range of a center.

34. W. Baumal and E. Ide, "Variety In Retailing", Management Service, III, (1956), 93-101.

35. R. Mayfield, "The Range of Central Goods In the Indian Punjab", Annals of the Association of American Geographers, LIII, (1963), 38-49.

36. M. Williams, Op. Cit.

37. E. von Boverter, "Spatial Organization Theory As A Basis for Regional Planning", Journal of the American Institute of Planners, XXX, (May, 1964), 80-99.

B. Berry³⁸ illustrated how the construction of a new first class highway affects the trading patterns within a given area; i.e. with easier and more rapid transit to a larger center, the people bypassed the original center (Marysville), where they had previously conducted the majority of their business.

Distance is not merely considered to be a linear expression but comprises all those elements affording advantages or disadvantages converted into monetary terms (amount of time lost, transportation costs, nature of the trip, etc.). Thus, distance is defined as economic distance³⁹.

As previously mentioned (page 9) there are two limits to be considered - the lower limit which represents the number of people necessary before a central function could become operative, and the upper limit represented by the maximum distance from which a sale can be expected, i.e. a point beyond which the item can be purchased more cheaply in another center.

The major elements accounting for the range of a good as referred to by Christaller, still assume prime importance in view of more recent works. Namely, these are:

- 1) Size and importance of a place
- 2) Price willingness on the part of the consumer
- 3) Subjective economic distance
- 4) Type, quantity and price of a good.

38. B. Berry, "The Impact of Expanding Metropolitan Communities Upon the Central Place Hierarchy", Annals of the Association of American Geographers, L, (1960), 112-16.

39. W. Christaller, Op. Cit.

IV. TRADE AREA

The trade area for any central place is intricately bound with relationships between Centrality and Range of a Good and its limits are derived from the importance and influence of the same two elements. Therefore, an attempt to separate these concepts along rigid lines cannot be accomplished. A note of importance in any of these sections is similarly relevant to the others.

Several terms have been used to define the area which supports any given center; e.g. umland, hinterland, market area, tributary region, complementary region, field of urbanism. For various reasons, some are more appropriate than others. The disagreeable connotation in "umland", stems from the implication of a secondary area (rural), being overshadowed by the more primary central place. Also, inherent within the term is the idea of dependence upon the place. In that it lies within the radius of a center's range of goods it may be considered the umland, but this is surely not adequate to offset the other two suggestions.

Hinterland, on the basis of definition means "backwoods", or remote parts; a very undignified and biased portrayal of those who patronize a center. A more conservative use of the term occurs in reference to the area around port facilities, but then, not all central places are ports.

Market area is a more acceptable term but it implies a one-way flow of advantages.

Field of urbanism has been criticized on the grounds that it hints of political influence. However, this may be as objectionable as it is real.

Tributary area and complimentary region better express the mutual relationship: from town to country, from country to town.

Within the theoretical framework of Christaller and L"osch, an hexagonal trading area would be the most logical form (page 10). A further argument postulated by L"osch was the denial of excess profits.

However, the structure of our economic system is one of a profit and loss system. "Profits are the carrots held out as an incentive to efficiency, and losses are the kicks that penalize using inefficient methods or devoting resources to uses not desired by the spending consumers."⁴⁰ It is customary practice to include normal profits in the costs of a firm which establishes a state of equilibrium when marginal costs equal marginal revenue. The problem then, is whether or not this equilibrium occurs. Being of a dynamic nature, it is difficult to perceive of human activities initiating and sustaining such a stable condition as equilibrium. Rather, through the medium of free entry, there is a constant coming and going in many fields of business.

Samuelson⁴¹ notes that excess profits cannot exist in Perfect Competition, (i.e. where supply and demand are established by the consumer), but that excess profits are a reality in Monopolies, Oligopolies, and Monopolistic Competition (we are here concerned with the latter), in the short run. (Fig. 13).

40. P. Samuelson, Economics (5th edition), McGraw-Hill, (New York, (1961)), 460.

41. P. Samuelson, Op. Cit. Chapters 4, 24.

The steepness of "d", represents the differentiation of one firm from the others; i.e. a steep slope denotes a well established firm, while a flatter slope illustrates a less well-established firm. Generally, in Monopolistic Competition firms, the curves are relatively flat because of the presence of substitute goods. The height of "d", is determined by the firms in the industry as a whole. However, if a firm is well established, it would be able to charge \$1.70 per unit where the going price is \$1.50 per unit. This is particularly evident in firms such as dry cleaning, barber shops, grocery stores, etc.

In the diagram, equilibrium (Price per unit), is established at the point, "E", where Marginal cost = Marginal Revenue. The point, "B", on the AC curve represents the price below which a firm will stop producing (i.e. additional costs are greater than additional revenue).

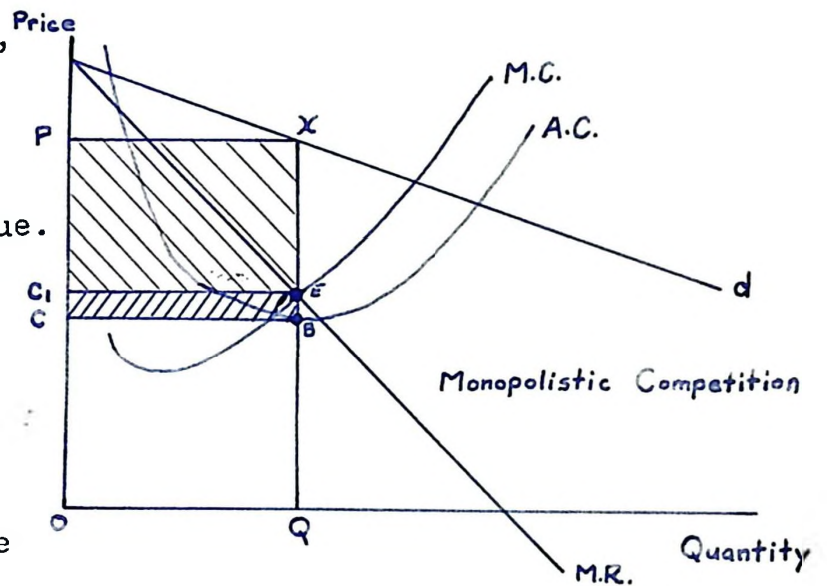


Fig. 13.

- M.R. - marginal revenue
- M.C. - marginal cost
- A.C. - average cost
- d - demand curve
- E - equilibrium

Total Profit = $PXBC$

Total Costs = C_1EQO

Since normal profits are to be included in total costs, then $C_1EBC = \text{normal profits}$ and $PXEC_1 = \text{excess profits}$.

Thus the demand schedule for the short run, indicates the presence of excess profits.

We may assume however, that once these excess profits are realized, other firms will begin to invade the field in an effort to soak up the surplus. We may further assume that this influx will continue to the point where the surplus is no longer great enough to support another complete firm. At this point no further entrant would be afforded the assurance of success. Further, a most irrational conclusion would embody the assumption that all firms are efficiently operated. Even if the point were reached where only normal profits were realized by all competitors, the changing structure of society would cause someone to fail in his endeavour or alternatively, create a larger market through technological advances.

Long run equilibrium, based upon numerous, past, short run data is a constructed illusion, an average; and as an average it is rarely ever attained. Actually, the systems are proceeding through successive phases of disequilibrium, each tending toward, but never actually realizing the final objective. Thus, excess profits exist.

Similarly, in connection with theories of retailing, ⁴² Holton argued that all products will be sold for which marginal revenue exceeds marginal costs - this is equivalent to Berry's and Garrison's idea of threshold. (see further in this paper, below). Sales are expanded to the point where marginal profits are all zero as determined by the upper limit of the range. Usually, stores will be located such that consumer movement is minimized and profits maximized, but for all other products lower in order than those of a marginal nature, it is possible to earn excess profits.

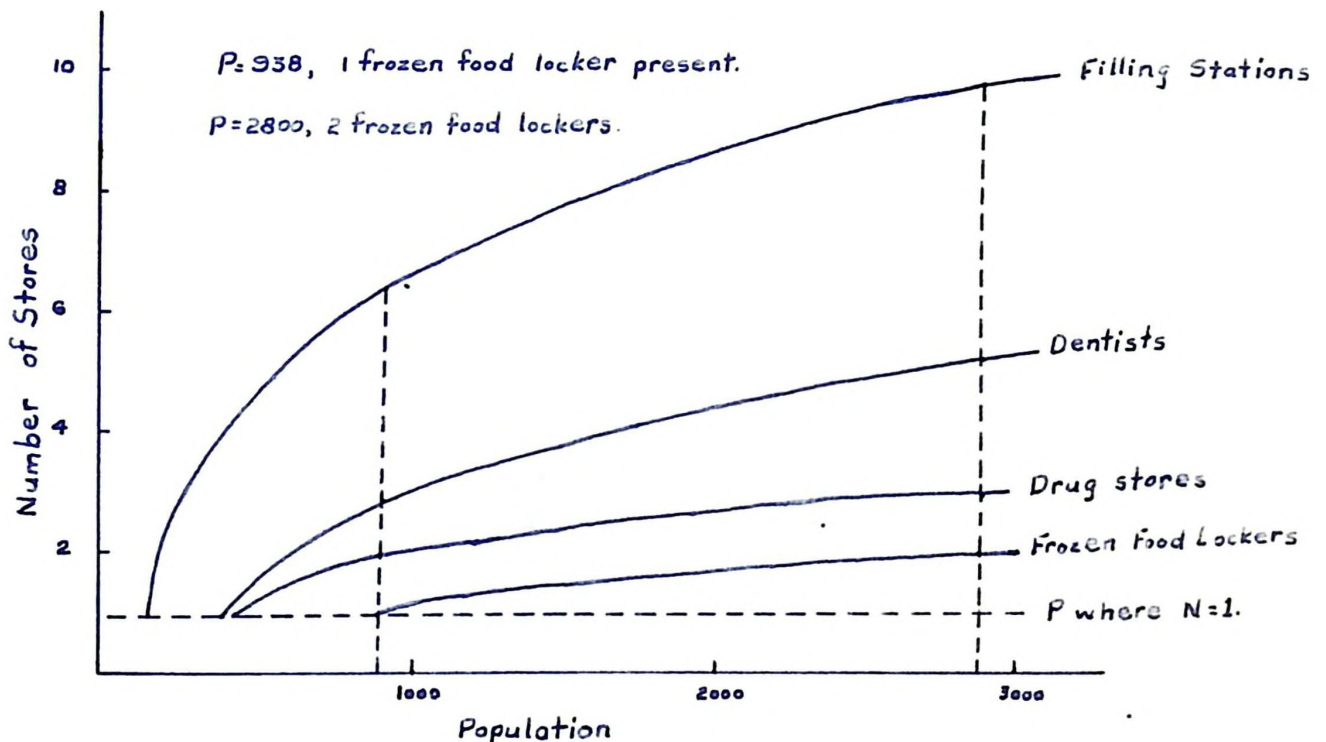
42. R. Holton, "Price Discrimination at Retail: The Supermarket Case", Journal of Industrial Economics, VI, (1957), 13-32.

Berry and Garrison⁴³ also questioned L^ösch's observation that excess profits would not be feasible. In identifying their populations, they used the idea of "threshold population"⁴⁴.

A scatter diagram was prepared for each of the central functions and a best fitting curve was established for each of the diagrams using the Standard Least Squares Method, from the expression $P = A(B^n)$ where: P = population

N = number of stores

A plus B = parameters to be estimated.



Rates of duplication of functions in Snohomish County. At a pop. level of 938, there are 1 frozen food locker, 1.9 drug stores, 2.7 dentists, 6.3 filling stations.

43. B. Berry and W. Garrison, "A Note on Central Place Theory and the Range of a Good", Economic Geography, XXXIV, (1958) 304-11.

44. Population Threshold refers to the minimum number of people required in a center for the first complete store to appear. Purchasing power in a center has also been suggested but the degrees of variability among the socio-economic groups makes this a less desirable criterion.

Once the best fitting curves have been established for each of the functions, they can be superimposed on the same graph and from its population, one can determine the number of functions the center is capable of supporting.

In using the above expression, the portion of establishments which accrue, indicates the possibility of an establishment earning excess profits; e.g. the population was great enough to support 1.9 druggists but since there was only one, he earned greater profits than if a state of equilibrium prevailed. Similarly, it can be shown that for two establishments of the same function to occur, a population greater than double the original size is required.

The authors themselves recognize two assumptions in their work: 1) constant basic-nonbasic ratio within the city
2) constant multiplier effect. 45

It has also been noted that these two assumptions must be true if the population threshold is to be a significant index of the inner range. The Basic-Non Basic Ratio refers to the activities of any center. Basic activities are those which bring capital into the center, e.g. - sales of manufactured goods made outside the producing city. Non basic activities are those which do not lure new capital to a center but merely represent an exchange of the capital already there, e.g. - a barber buys groceries - both live in the same town. It may be argued that the barber used money obtained from a person from

45. H. Hegeland, The Multiplier Theory, Lund Social Science Studies, (Lund (1954)), 183-86.

The spatial multiplier, which can be applied to a country, or several countries, is usually smaller, the smaller the given sector is to which it is applied, for the larger fraction of the multiplying effects of new investment projects leaks to other areas. The larger the area, the fewer the leaks. Therefore, the smaller the sector, the less fruitful it is to deal with the effects of changes in the rate of investment outlays.

outside the city (a tourist); however, the bulk of his fees probably come from customers within in the center.

Thus, if either of these activities changes appreciably, the concept of threshold no longer remains relevant.

Although there is a lack of empirical work to justify these assumptions, a complementary study by Morrill⁴⁶ in Sweden shows that excess profits are enjoyed in the real world; e.g.

In 1910 in Sweden, fourteen central places had developed, (within the study area), whereas the population was great enough to support eighteen, largely as a result of historical consequences which saw the centers placed far enough apart to reap the benefits of excess profits, but too close for other centers to develop in the interstitial spaces. In any event, this study by Berry and Garrison, producing factual material as it did, represents one of the major revolutions to take place in Central Place Studies. By removing the rigid limitations created by the hexagonal system, more freedom is allowed for the operation of productive forces to influence the location and growth of centers at select sites, yet without marring the concept of an hierarchical classification.

Sven Godlund⁴⁷ used bus routes in an attempt to delimit the trade area. In studying the sphere of influence for various centers for bus travel he has shown how, as the population could support more and more central place activities, new central places were able to enter approximately midway

46. R. Morrill, "The Development of Spatial Distribution of Towns in Sweden, An Historical-Predictive Approach," Annals of the Association of American Geographers, LIII, No. 1, (Mar. 1963), 1-14.

47. S. Godlund, "The Function and Growth of Bus Traffic Within the Sphere of Urban Influence", Lund Studies in Geography, Series B, No. 18, (1956).

between the old ones as suggested by Christaller. However, bus service analysis is not applicable to any great extent to the study areas of high order places - some other technique must be used. Persons travel to higher order centers for specialized services and goods and must use other means of transport. e.g. In travelling to London, England, whose hinterland covers the whole country for some goods, transport is usually by train. ⁴⁸

What this method does reveal, is where the majority of persons wish to make the majority of journeys, and, as bus transport is usually the cheapest and most convenient form of public transport, its hinterland is the first and most significant sphere of influence that a planner can use for the purpose of analysis.

48. F. Greene, "Urban Hinterlands in England and Wales: An Analysis of Bus Service", Geographical Journal, CXV, (1950), 64-88.

V. SIZE OF CENTRAL PLACES:

That central places differ in respect to size is readily admissible, but why they vary in size presents a more complex problem. Without second thoughts, a proper response would probably be, "because of a greater number and variety of opportunities." But how does a central place attain this status in the first place?

Since Christaller's original study, a considerable amount of work has accumulated,⁴⁹ largely theoretical in nature but of late more empirical research has entered the field. Much of the information is associated with the relationship between functions and population. The Christaller concept as previously noted, considers each class of centers within the hierarchy functionally more complex than those classes of centers preceding it. Therefore, because it is supported by more functions, it accrues a greater source of revenue, and, being able to support more people, adopts a discrete population level in accordance with the number of functions present.

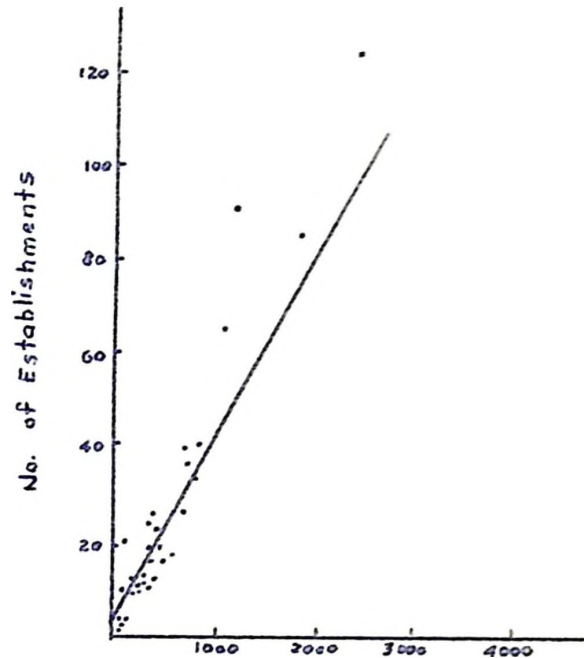
49. B. Berry and A. Pred, "Central Place Studies: A Bibliography of Theory and Application", Regional Science Research Institute. (1961)

Thomas⁵⁰ and Stafford⁵¹

carried out identical studies in two different states; ~~Illinois~~^{Iowa} and ~~Iowa~~^{Illinois} respectively, to test for the relationships that possibly existed between:

- 1) Number of Establishments and Population.
- 2) Number of Functions and Population
- 3) Number of Functional Units and Population.

The basic aim was to find out if any of these elements could be directly related to the size of a place, thereby facilitating an explanation for the spatial distribution of central places and a possibility for predictive approaches.



1960 Pop. Fig. 14

After the sets of data had been tabulated for the first analysis, (Fig. 14), a very close relationship was found to obtain in both studies. The coefficients of Simple Correlation both approximated +0.9. Thus the wide variations in population size are matched by a wide range of establishments per town. Even in areas where the population is declining, the number of establishments is quite responsive to population change so that population changes over time are quickly reflected in the number of establishments. The major limitation to this generalization

50. E. Thomas, "Some Comments on the Functional Bases for Small Iowa Towns", Iowa Business Digest, XXXI, (1960), 10-14.
51. H. Stafford Jr., "The Functional Bases of Small Towns", Economic Geography, XXXIX, (1963), 165-175.

occurs in the form of a negative decrease; i.e. with constant increases, new establishments are erected to serve the needs and demands of the increased population. Unfortunately, if an area has encountered adverse conditions and experiences a negative change in population, the buildings are left at their sites, not demolished. A more exacting method would be to include establishments in use only. This might possibly call for fractions of establishments in use, but some sort of classification could be effected for such a study. In any event, there was a high degree of correlation in both studies while the regression equations illustrated linear relationships in both cases:

$$\text{Iowa: } y' = 9.60 + 6.6x$$

$$\text{Illinois : } y' = 5.49 + 3.8x$$

Thus the establishment increase is 6.6 per 100 persons in Iowa, while in Illinois, the increment is 3.8 per 100 persons. This difference is not important. What is more significant, is the fact that the number of establishments are directly proportional to the number of people per town and there is no significant difference in the relationship between population size and the number of establishments for small towns in Iowa and Illinois.

The number of functions is less than the number of establishments largely because of the tendency for a number of establishments to perform the same function in a given town: e.g. there may be 3 or 4 gasoline stations = 3 or 4 establishments but only one function. The smaller the town size, the more equal the two factors become in number possibly because of the inability of the smaller place to support more than one establishment of a given type.

Once again, a Regression Equation Comparison shows that the nature of the association is quite similar:

$$\text{Iowa: } \hat{y} = 39.91 \log x - 66.31$$

$$\text{Illinois: } \hat{y} = 24.52 \log x - 46.63$$

The relationship is not linear (Fig. 15) as it was in the previous analysis for number of establishments and population. A further interpretation from this figure concerns the increase in the number of functions. As small towns increase in size, so do the number of functions but at some critical point, the increase occurs at a decreasing rate. This is due to the ability of a place to support a given number of functions. In its primary stages a center has need of several functions to satisfy local demand. As the population continues to increase, the number of new functions capable of being supported become fewer and fewer.

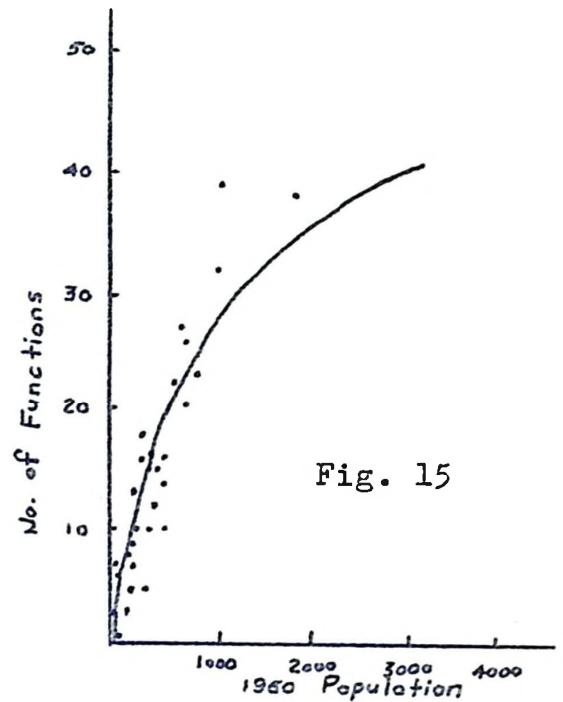


Fig. 15

A similar relationship exists between the two studies in the comparison of Functional Units to Population.

The Snokomish County Study,⁵¹ the most highly regarded piece of literature to emerge, was initiated with the specific aim of establishing a significant relationship between population levels and functional complexity in the verification of discrete population levels in the hierarchic classification. The first step was to rank the functions and centers. Functions were further broken down to include:

51. B. Berry and W. Garrison, "The Functional Bases of the Central Place Theory", Economic Geography, XXXIV, (April, 1958) 145-54.

- 1) Variates: the number of stores performing those functions varied from place to place. e.g. Barber shops.
- 2) Attributes: either a center had a unit performing such a function or it did not. e.g. Telephone exchange.

The r_q variates considered, were investigated on the basis of population threshold, after which it was possible to rank them according to the number of persons required in a center for the first complete store to appear.

The relationship between the attributes and the population was obtained from the point biserial coefficient of correlation and ranking was thus possible from the observation that larger centers corresponded with higher coefficients. The chi-square test for randomness, to determine the existence of associated classes of activities, yielded three groups in the case of variates while through the use of standard techniques, the attributes also showed three distinct groups of activities. The chi-square test was again used for the ranking of centers which illustrated a tendency toward discrete levels of population among three classes of central places. (Fig. 17)

Through the analysis of variance, significant differences were demonstrated to be realities between groups of functions and between central places and that the differences were greater between the groups than within the groups.

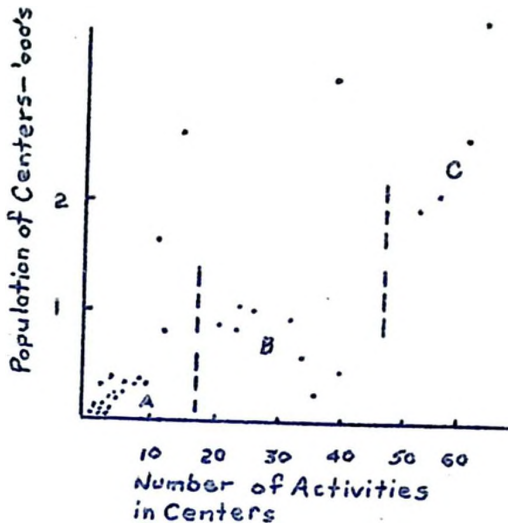


Fig. 16 - Classes of Central Places for Snohomish Co.

In Fig. 16 there are four exceptions to the generalization of levels in terms of population. Berry and Garrison note that these centers have experienced very rapid increases in population in recent years, becoming dormitories for the Seattle area. Thus, the functional deficiency is attributed to a time lag between the service industries and the rapidly advancing population causing a population function imbalance.⁵²

* A value of 1.0 means that every center of the particular class in question will tend to have one store providing each function, of the group of functions in question - e.g. class C centers with the functions of Group 2₂

NUMBER OF STORES PER FUNCTION PER CENTRAL PLACE IN THE CLASSES OF FUNCTIONS AND OF CENTRAL PLACES IN SNOHOMISH COUNTY, WASHINGTON.			
Central Functions	Classes Of Central Places		
	A	B	C
<u>VARIATES:</u> Group 1 ₁	0.65*	2.91	6.29
Group 2 ₁	0.04	0.77	2.65
Group 3 ₁	0.01	0.21	1.00
<u>ATTRIBUTES:</u> General Store	0.70	0.11	0.00
Group 1 ₂	0.20	0.45	1.00
Group 2 ₂	0.04	0.50	1.00
Group 3 ₂	0.03	0.28	0.88

Table 1

52. Several studies have been conducted considering the population function relationship.

E. Thomas, Op. Cit.; H. Stafford Jr., Op. Cit.; L. King, "The Functional Role of Small Towns in Canterbury", Proceedings of the 3rd N.Z. Geo. Conf., Palmerston North, (1961).

Concerning deviant cases; Thomas referred to the nearness of the centers to a larger town and an unusual amount of activity while King reflects the importance of a large manufacturing component in the towns economic base (both similar to Berry and Garrison). Stafford notes that in Southern Illinois, Vienna has more establishments, functions and functional units than expected on the basis of population and due to the relative isolation of this county seat town from towns of comparable size. There is also some deviation in the differences among the four areas in the type and importance

Another method has been employed which makes use of the urbanization curve ⁵³ and the coefficient of urbanization ⁵⁴ in order to better determine the relationship between urbanization and retail specialization. The total dollar volume of retail sales was tabulated for each of sixty kinds of business categories, by size groups.* The cumulative proportion of the total sales was then plotted against the cumulative proportion of the sales by kind of business on a Lorenz type graph. (Fig. 18)

The method for computing the urbanization coefficient is illustrated in Table II.

*In that we are trying to show a relationship between certain goods and services, and the extent to which a place is urbanized, the arbitrary assignment of population to certain classes is not a relevant factor.

52 Cont'd. - of the various functions. This may be partially explained; 1) by variations in data collecting techniques; 2) by regional economic variations - i.e. the two regions most similar in terms of functional bases of their central places, Iowa and Illinois, are the two which are closest together. Finally, no central place studies should expect to find exactly the same results - what is important is that a high degree of similarity is found to be consistent.

53. E. Hoover, "The Measurement of Industrial Realization", Review of Economic Statistics, XVIII, (Nov. 1936), 162-77. He derived an expression for, and coined the term "index of urbanization". However, he worked with data from individual cities rather than city size groups as Duncan did.

54. O. Duncan, "Urbanization and Retail Specialization", Social Forces, XXX, (1952), 267-71.

In Fig. 17, the dashed diagonal line represents the hypothetical case of zero urbanization, where the cumulative distributions are identical for the given kind of business and for the total sales. Curves for fur shops (B), indicate a rather considerable concentration of sales in the larger cities (positive value), while the opposite extreme is exemplified by general stores (A), where sales are heavily concentrated in rural areas (negative value).

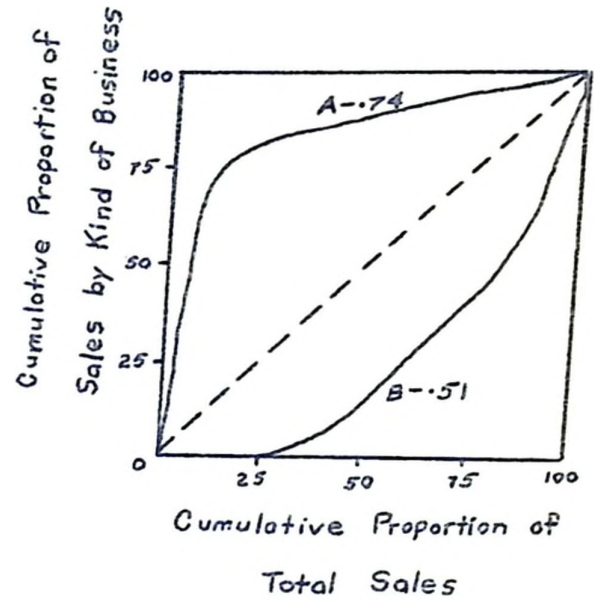


Fig. 17, Urbanization Curves For 2 kinds of Business
A-General Stores; B-Furriers

Table II: Computation of Urbanization Coefficient for Furrier and fur Shops (1948)

City Size	TOTAL SALES			Furriers, Fur Shops; Proportion of Sales (4)	Product (3)x(4) (5)
	Prop. of Sales (1)	Cumula- tion of (1)-(2)	2 Point Total of (2)-(3)		
Under 2,500	.183	.183	.183	.010	.001830
2,500-4,999	.054	.237	.420	.007	.002940
5,000-9,999	.074	.311	.548	.011	.006028
10,000-49,999	.201	.512	.823	.086	.070778
50,000-99,999	.084	.596	1.108	.084	.093075
100,000-249,999	.096	.692	1.288	.111	.142968
250,000-499,999	.076	.768	1.460	.091	.132860
Over 500,000	.232	1.000	1.768	.600	1.060800
Total	1.000	--	--	1.000	1.511276

Coefficient of Urbanization = (Total, Column (5)-(1))=.51; (see Fig.15))

A very rural kind of business is not interpreted as one in which the majority of sales are necessarily transacted in rural areas, rather it is one in which there is a concentration of sales in rural areas and small towns, compared to the total sales of all business. It is on the basis of this statement that I have inferred the index of centrality to be representative of the degree of specialization functions which were noted previously, i.e. functions with a high index of urbanization would be the more highly independent specialty shops and characteristic of larger centers, while a low index of centrality would be representative of the more general necessities demanding frequent purchase and obtained in lower order centers.

Categories designated according to this system were:

- a) Very Urban - General Merchandise and Apparel Shops
- b) Slightly Urban - Furniture, Appliance and Second Hand Stores
- c) Neither Urban or Rural - Food, Drug and Proprietary Stores, Liquor Stores, Automotive Group and Eating and Drinking Places
- d) Very Rural - General Stores, Gasoline Service Stations, Lumber, Building and Hardware Group.

The low index of urbanization of gasoline service stations is explained possibly through the heavy proportion of suburban and open highway locations. It was further noted that no noteworthy change occurred from 1939 - 1948.

The general array of functions investigated by Duncan shows a similar degree of comparison to those of the Snohomish County Study. The main encumbrance of most studies considering the retail sales has been overcome. Rather than comparing the total sales to the population, Duncan has compared the total sales

and total sales of each type of function. Therefore, no matter in what part of the country a study based on this method is conducted, a degree of similarity should be expected.

We can generalize here and say that the size of a central place is derived from its functional complexity.

VI. RANK-SIZE RULE: (AN ALTERNATE EXPLANATION)

Being an empirical regularity, the Rule has received unwarranted plaudits as an alternate description of the spatial distribution of cities and towns. Zipf⁵⁵ stated that the cities of a country are arranged according to size in descending order, the nth town having a population of $\frac{1}{n}$ of the first; the 10th town = $\frac{1}{10}$ the population of the first; the second town = $\frac{1}{2}$ the population of the first. (Fig. 18)

It is expressed in the form of:

$S_R = S_1/R$ wheel⁵⁶

S_R = size of city with rank R

R = rank in size of a given city

S_1 = size of largest city

With rank expressed as a function of size the relationship is of the form of a cumulative "greater-than" frequency distribution applied to the description of cities.

R. Vining has been much more exacting than Zipf and produced a most efficient

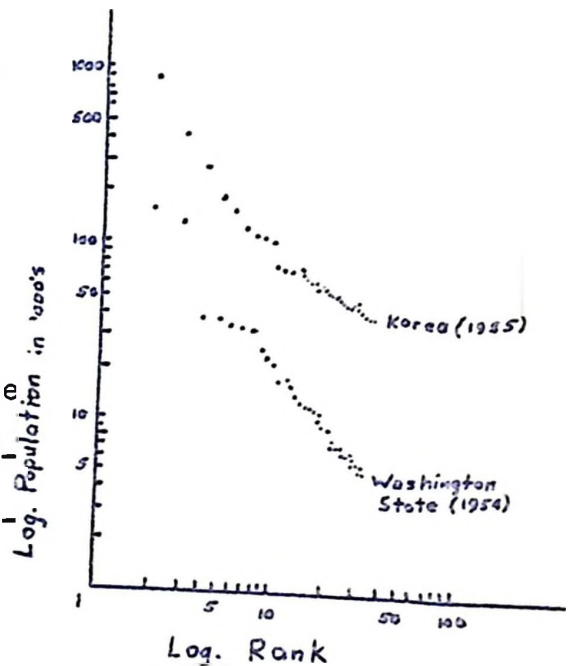


Fig.18: City Rank-Size Relationships: Republic of Korea and Washington State

- 55. G. Zipf, "National Unity and Diaunity, (Bloomington, Indiana, (1941)).
- G. Zipf, "Human Behaviour and the Principle of heart Effort", (Cambridge: Addison-Wesley Press Inc., (1949)). Zipf's discussion occurred in connection with a general theory of human behaviour, in which rank-frequency relationships are noted for many expressions of human behaviour.
- 56. R. Vining, "A Description of Certain Spatial Aspects of an Economic System", Economic Development and Cultural Change III

empirical piece of work, supporting as it does, the argument for the Rank-Size Rule. In place of the hierarchic classification, Vining preferred to consider the distribution of cities as occurring along a continuum. He particularly rejects the methodology⁵⁷ used by Brush in the Wisconsin Study, stating that the classes and their trade areas have been arbitrarily assigned. We have already reviewed several studies which appear to make his objection to arbitrary selections an invalid one; (Berry and Garrison, Thomas, Stafford and Duncan).

The basic criticism underlying Vining's attempt to inaugurate the Rule as a more adequate method than Central Place Theory to account for the size and spacing of cities was that the two schemes are incompatible. Actually, they are^{measuring} different criteria. While Central Place Theory is endeavouring to describe the size and spacing of classes of centers according to their relative importance, the Rank-Size Rule is striving to effect an explanation for the association of singular places, one to the other, as they exist in respect to their population levels and not by a measure of importance. Thus, this system would include all centers; e.g. mining and lumbering towns, resorts and spas, transportation centers and central places; and so there can be no real argument that this rule is contrary to Central Place Theory, especially since it assumes virtually no role in accounting for actual spatial distributions.⁵⁸

Stewart⁵⁹ has seriously questioned the validity of the 57.R. Vining, Op. Cit. (pages 167-69)

58. This argument is continued later in "Proofs of the Central Place Hierarchy" through reference to the more recent works of Beckmann and Berry and Garrison; Berry et al.

59. C. Stewart Jr., "The Size and Spacing of Cities", Geographical Review", XLVIII, (April, 1958), 222-45.

Rank-Size Rule. He notes that the rule is relevant for towns and small cities whose functions and complementary regions are limited, but that it breaks down for larger cities. London, for example, is too large for the other British cities to fit. Also he found that countries which have an external trade: total trade ratio of less than 10% (U.S.S.R and the U.S.) often fit the rule satisfactorily.⁶⁰

Table III is presented to illustrate the ratio of the population

Ratio:	1-1.5	1.5-2	2-2.5	2.5-3	3-4	4-5	5-10	10-
No. of Countries:	14	6	9	2	20	3	16	2

Table III.

of the largest city to the second largest city in each of twenty-two countries. (Divided countries - Germany and countries that were too small - Iceland, were not included). According to the rule, there should be a cluster of centers around the 2 -- but only 15 of the 72 occur between 1.5 and 2.5. The values ranged from 17.0 - Uruguay to a median of 3.25 to a low of 1.2. Among the world's giant countries, Brazil, India, U.S.S.R and Australia have ratios below 1.50. Canada = 1.51, while the U.S. and China have ratios of 2.18 and 2.24 respectively. Observing that these low ratios could possibly be accounted for by their large areas, Stewart proceeded to establish the relationship of the population for the 5 largest cities in each major political division of the largest countries (some data not available - none for China).

60. B. Berry, "City Size Distribution and Economic Development", Economic Development and Cultural Change, IX, (1958) 573-88. Berry helps to explain some of the inadequacies and deviations observed by Stewart. As noted, rank-size regularities have been associated with the existence of integrated systems of

Table IV shows the results between the 2 largest centers. Most of these political divisions show less diversity than the country

Ratio of Population of Largest City to Population of Second Largest City

Country	1-1.5	1.5-2	2-2.5	2.5-3	3-4	4-5	5-10	10-	Median
Australia	0	1	0	0	0	0	0	5	14.24
Brazil	2	1	3	0	2	4	2	6	4.82
Canada	2	1	2	0	1	0	4	0	2.84
India	6	4	0	1	5	2	2	0	2.37
U. S.	14	6	7	5	6	1	4	5	2.31
U. S. S. R.	3	2	1	2	2	2	3	0	2.67

Table IV.

as a whole. Thus it applies properly only to diverse regions and that for fairly large cities the rule breaks down in small homogeneous areas. Stewart states that only tentative conclusions can be drawn from the data because of the great diversity in size of countries, states and provinces.

Median Size of 5 largest Cities as a Fraction of the largest:

Country	Largest	Second	Third	Fourth	Fifth
72 Countries	1	0.315	0.200	0.140	0.120
Australia	1	0.076	0.0405	0.024	0.019
Brazil	1	0.210	0.135	0.105	0.0785
Canada	1	0.340	0.220	0.140	0.078
India	1	0.440	0.365	0.280	--
U. S.	1	0.435	0.310	0.200	0.165
U.S.S.R.	1	0.375	--	--	--
Rank-Size Rule	1	0.500	0.333	0.250	0.200

Table V.

Table V shows results for the five largest cities in each of the giant countries. Considerable variation occurs from the Rank-Size Rule -

- 1) Most second cities are much less than $\frac{1}{2}$ the largest.
- 2) Difference between the 2nd-3rd and 3rd-4th is greater than the rule postulates
- 3) Generally, the divergences are small except for that between the first and second cities.
- 4) The range values for any two successive cities is large and does not cluster around a central point.

As an alternative, the Rule, which breaks down at both extremes and is not consistent in between, leaves much to be desired.

60. Cont'd. from page 57.

cities in economically advanced countries, whereas primate cities (sometimes called parasitic) have been associated with overurbanization in underdeveloped countries.* By using the chi-square test it was found that the arrangement in countries was not significantly different from that which could have arisen at random so it was concluded that there was no relationship between city size distribution and the degree of urbanization, e.g. log normal cities with low urbanization - China, India, Korea; while countries with primate cities and high urbanization, Spain, Netherlands, Uruguay. Therefore all of these countries deviate from the commonly hypothesized but non-existent relationship between urbanization and rank-size regularities.

*Unesco, "Report by the Director-General on the joint U.N. Unesco Seminar On Urbanization in the E.C.A.F.E. Region", (Paris, (1956)).

VII. SPATIAL DISTRIBUTION

Table VI shows the estimations derived by Christaller for the ideal distribution of centers within his system. Other

Central Place	Towns		Tributary Areas	
	Distance (KM.)	Population	Size (Sq.K.M.)	Population
Hamlet	7	800	45	2,700
Township Center	12	1,500	135	8,100
County Seat	21	3,500	400	24,000
District City	36	9,000	1,200	75,000
Small State Capital	62	27,000	3,600	225,000
Provincial Head City	108	90,000	10,800	675,000
<u>Regional Capital City</u>	<u>186</u>	<u>300,00</u>	<u>32,400</u>	<u>2,025,000</u>

Table VI.

studies have been carried out more recently, with similar results regarding the distances moreso than the population figures. We have already noted the studies by Brush and Bracey⁶¹ in connection with Centrality (pages 21-23). Although it is difficult to understand just what Bracey actually did measure in his study (lack of differentiation among goods), we might assume that he arrived at a total degree of centrality for each place on the basis that each higher order center would offer not only those goods and services unique to its particular size, but also those commodities obtained in the smaller centers as well (i.e. necessities and daily requirements). In this manner, the significance

61. J. Brush and H. Bracey, "Rural Service Centers In Southwestern Wisconsin and Southern England", Geographical Review, XLV, (1955) 559-69; J. Brush, "The Hierarchy of Central Places in Southwestern Wisconsin", Geographical Review, XLIII, (1953), 380-402; H. Bracey, "Social Provision in Rural Wiltshire," (London, (1952)); idem, "Towns as Rural Service Centers", Institute of British Geographers Publication, No. 19, (1954), 95-105; idem, "A Rural Component of Centrality Applied to Six Southern Counties in the United Kingdom", Economic Geography, XXXII, 38-50

of lower order goods would be offset due to the immediate demand of the consumers in all areas, yet the higher order place would obtain a higher index due to its greater attraction for those consumer commodities available only at its center. Table VII shows a comparison of the data collected by the two authors.

Table VII.	<u>High Order Centers</u>		<u>Low Order Centers</u>	
	19 Towns - South West Wisconsin	26 High Districts Centers - S. Eng.	73 Villages S.W. Wisconsin	44 Low Order Dist. - S. Eng.
Median Population	2,515	13,800	400	5,080
Mean Population	3,330	25,950	480	12,425
Mean Size of Service Area (Sq.mi.)	129	128	32	48
Mean Population of Service Area	2,440	21,080	610	7,180
Mean Intercenter Distance	21	21	10	8

* Medians of population were used since they provide a better basis for comparison than the means due to the existence of a few large centers in Southern England, which unduly weight the Means.

The most significant observations are reflected in the similarities between the distances of the centers.

- 1) The higher order centers in both circumstances correspond closely to those of Christaller - 21 mi.
- 2) Lower Order Centers occur at mean distances of 8 mi. and 10 mi. respectively in England and Wisconsin (Christaller postulated 12 mi.)

3) Smaller centers which would correspond to hamlets are at intervals of 4-6 mi. and 5-6 mi. in Somerset, England and Wisconsin respectively (Christaller postulated 7 mi.) Dickinson⁶² found in East Anglia that small centers (1,000-2,000 pop.) were spaced at approximately 4 mi. intervals also.

That population levels would not be similar or that the same groups of activities would predominate in the respective centers of the different regions, due to different social and cultural traditions, and because of a lengthier period of development in one area than another could be expected. Because of these differences one would anticipate a considerably larger complementary region in England than in the less populous region of Wisconsin.

Further reference can be made here to Kolb and Brunner,⁶³ Table VIII, who establish a pattern of spatial regularity among central places. Two major interpretations can be derived from this table:

- 1) the larger the village, the larger the complementary region.
- 2) the sparser the rural population density, the larger the tributary region in each subset - e.g. large villages in Mid-Atlantic - 87 square miles; large villages in Far West - 223 square miles

Community Area In Square Miles

Table VIII

<u>Region</u>	<u>Small Villages</u> (250-1,000 pop.)	<u>Medium Villages</u> (1,000-1,750 pop.)	<u>Large Villages</u> (1,750-2,500 pop.)
Mid Atlantic	43	46	87
South	77	111	146
Mid West	81	113	148
Far West		365	223

62. R. Dickinson, "City Region and Regionalism, (London, (1947)) 87-89

63. E. de S. Brunner and J. Kolb, Rural Social Trends, (New York, (1933)), 95.

A similar pattern of distribution was found to exist by Lösch⁶⁴ as illustrated in Fig. 19. The one common factor that obtains in each of the studies referred to this far, is that of a relatively uniform land surface supported largely by non-industrial activities. Complementing

Brush and Bracey, small centers are close together while large centers are separated by greater distances and have larger complementary regions.

Assuming a relatively evenly dispersed population over a given area, an arithmetic formula⁶⁵ was computed and tested where:

- A = total area
- n = number of farmhouses
- $\frac{A}{n}$ = density of farms

A further assumption was that the area around each farmhouse was hexagonal in form and the distance "D" to the nearest six farmhouses is equal to two times the height of any one of the six equilateral triangles within the hexagon, then:

- 64. A Lösch, "The Nature of the Economic Region", Southern Economic Journal, V, (1938), 73.
- 65. J. Barnes and A. Robinson, "A Method for the representation of Dispersed Rural Population", Geographical Review, XXII, (1940), 134-37.

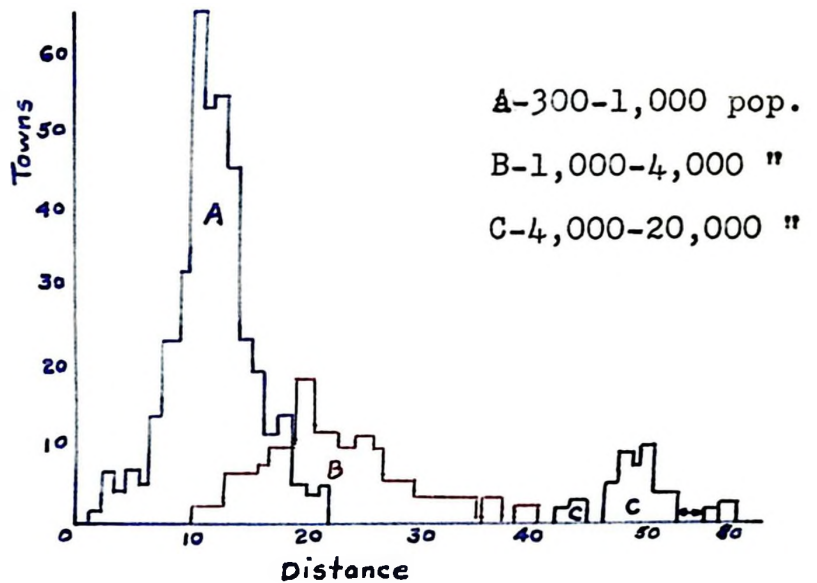


Fig. 19.

This diagram illustrates the minimum distances between three size classes of towns in Iowa; the number of centers decreases with increasing order; distance increases with increasing order.

$$\begin{aligned}\frac{A}{n} &= \frac{1}{2} \sqrt{3} \cdot D^2 \\ D &= \sqrt{\frac{2A}{n \cdot 3}} \\ &= 1.07 \sqrt{\frac{A}{n}}\end{aligned}$$

This expression was employed in actual study areas in these townships and yielded an error of less than 4% interpreted down to hundredths of a mile. However, the successful application of this method is dependent upon a relatively homogeneous dispersal of rural settlement and in an area of minimum relief.

Unfortunately, the procedure did little to relax the constraints of the original work by Christaller; the same limitations are emphasized through its use, namely; necessity of minimum relief, even distribution of population, rigid hexagonal trade area concept.

Further discussion here on the aspect of spatial distribution impinges upon the material that I have selected for the verification of an hierarchic system. The broadest generalizations that can be made have already been mentioned on the past two pages.

VIII. VERIFICATION OF A CENTRAL PLACE HIERARCHY: (note Snohomish County study).

Before much degree of success could be readily appreciated in persuading an hierarchical classification to more closely approximate the situation of the real world, the theoretical notions had to be released from their unyielding premises. Berry and Garrison,⁶⁶ realizing the problem, set out to reformulate the theory on the basis of a few simple concepts (i.e. population threshold and range of a good). Their successful refutation of the "no excess profits concept," in addition to a few simple concepts, they submitted, would permit the development of an hierarchy without any strict regulations. Implicit within the new idea was the emergence of an hierarchical spatial structure irregardless of purchasing power concentration. However, it is essential that two conditions are satisfied: a) a center of any level in the classification performs in addition to its own functions, those functions of lower orders as well; b) every center must be located at the point of maximum accessibility to the largest market area it can command. Under these conditions, one place of each type size will not suffice. If Center A is optimally located to serve all of the consumers, then only one center B, will not be able to be located in a position to reach all of the second threshold consumers, since some will reside closer to A, while others on the side of A remote from B will not be serviced at all. On the other hand, if both are optimally distributed to provide the second threshold goods,

66. Berry and Garrison, "Recent Developments of Central Place Theory", Papers and Proceedings of the Regional Science Association. IV, (1958), 107-20.

then clearly Center A will not be at its optimum position to offer the first threshold commodities.

Marshall⁶⁷ attacked the model on the basis of chronology; he complained that the authors neglected to consider a proper time sequence by beginning with the ordered place. He proceeded to set up his own model, an island situation, based on the aforementioned dictates and concluded with a distribution that bore no resemblance to that postulated by Berry and Garrison. The latter, penned a quick rebuttal⁶⁸ pointing out Marshall's error - he had failed to optimally locate center A, before proceeding to find the Good (g_1) with threshold (T_2) which would justify the existence of the next lower order centers. As far as chronology is concerned, the model can be established from either end - lower order centers or higher; it is merely easier to illustrate by beginning with the ordered place.

I should now like to outline and describe three studies, which I warrant are well conducted and in considering the concepts that we have discussed here, present a good argument for the existence of the hierarchical classification of central places with discrete population levels. Another paper is involved with a mathematical expression leading to the same conclusion.

The first involves a study by Berry et al⁶⁹ in

67. J. Marshall, "Model and Reality in Central Place Studies", The Professional Geographer, XVI, No.1, (Jan.1964), 5-8.
68. B. Berry, "The Case of the Mistreated Model," The Professional Geographer, XVI, No.3, (May, 1964), 15-16.
69. B. Berry, H. Barnum, R. Tennant, "Retail Location and Consumer Behaviour", Papers and Proceedings of the Regional Science Association, IX, (1962), 65-106.

Southwestern Iowa. ⁷⁰ On the basis of Central Place Theory, one would expect that large central places have more central functions supporting larger populations, more establishments, larger trade areas and more shopping centers. These generalizations were found to be true with linear relationships between population and functional units; and log linear relationships between population and functions. In the latter case, there were two deviants - both had a greater population, and were the only centers that had their populations supported by activities other than central functions. Therefore they have an excess of population if population is compared to the number of central functions they perform. (This compares favourably with the results obtained previously by Thomas (see footnote 52 page 51, with the results obtained previously by Thomas.)

70. The population density in the area was 15.5 persons per square mile. The main activity was farming - highly productive farms. The average farm size was 190A - 200A. Over the past few decades the number of farms have tended to decrease while sizes have tended to increase.

This has caused a decline in the rural population - Adams County, the poorest declined the greatest. As the rural population declined, so did the population of the towns with the exceptions of the County Seats which increased slightly. Data Source: 1) In 1960 a field crew was sent out to collect information. 2) An inventory was taken of the establishments performing central functions in the 9 counties from which maps were constructed to show these establishments. 3) Maps were made of trade areas for 76 selected establishments located in a sample of 20 central places. Maps were based upon interviews, charge accounts, cheques, delivery lists. Customers were asked about the origin and destination of their trip, type of transportation, establishments visited or to be visited. 4) Interviews were held with 150 rural families and 170 families residing in the Central Places. They were questioned concerning the place and frequency of shopping for groceries, clothing, furniture, gasoline and appliances, banking, dry cleaning, barber or beauty services. Of interest were the centers or center used to obtain most of these goods or services, other centers visited and whether phone, mail order, or delivery were used and the transport media.

But when central functions are plotted against the number of functional units, a log linear pattern is not maintained, (see Thomas), such that there appear to be several existing regimes. (Fig. 20A).

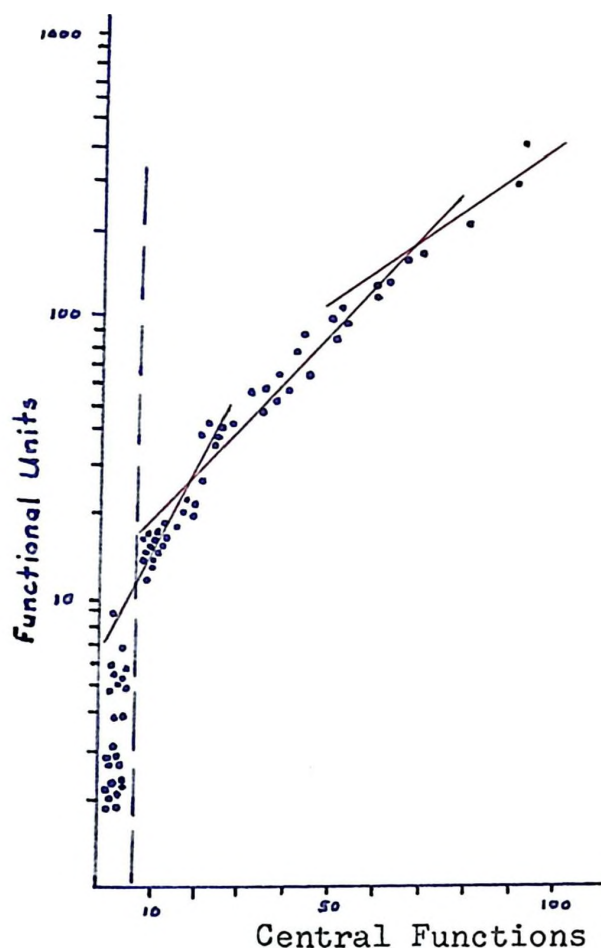


Fig. 20A

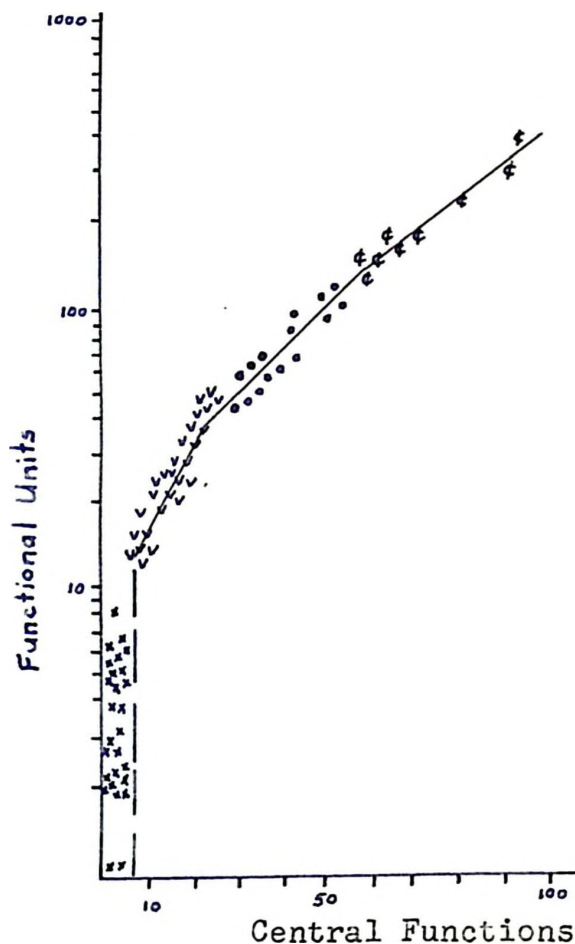


Fig. 20B

The use of direct factor analysis indicated 1) the presence of groups of central places characterized by groups of central functions and 2) that certain discontinuities existed in the order of entry, thus confirming the presence of both an overall pattern and separate regimes. (Fig. 20B).

In the intensive study area, as one moves out toward the north from the city of Red Oak, a progression of central places is as follows: (note the step-like pattern).

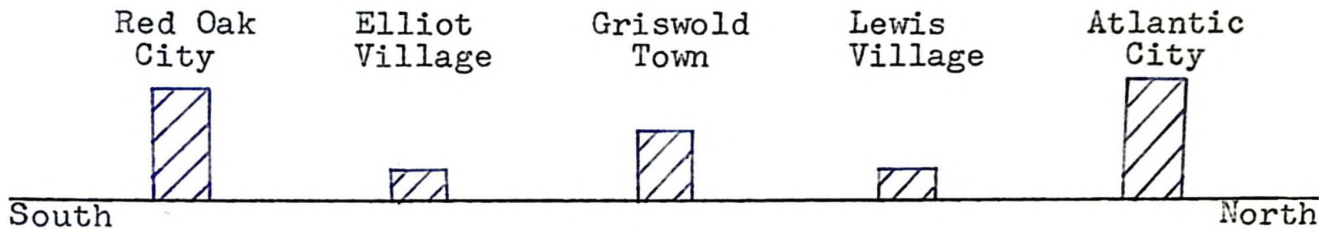


Diagram I:

Table IX, reveals similarities in population, central functions, and functional units of each class of center and readily depicts the jumps or definite stages from villages to towns and from towns to cities.

<u>City</u>	<u>Population</u>	<u>Central Function</u>	<u>Functional Units</u>
Red Oak	6421	90	312
Atlantic	6890	92	411

<u>Town</u>			
Griswold	1207	50	102
Anita	1273	50	84
Villisca	1690	43	90
Oakland	1340	49	97

<u>Village</u>			
Lewis	501	24	43
Elliott	459	26	42
Stanton	514	21	28

Table IX.

Villages exemplified by food and barber-beauty functions.

Towns exemplified by banks, dry cleaning, furniture, appliances.

Cities exemplified by clothing.

Generalizations:

- 1) The higher the order of the center, the larger its complementary region.
- 2) Urban residents patronize the town they live in almost exclusively - (illustrated in a set of diagrams).
- 3) The pull of the metropolis affected "comparison" shopping goods e.g. furniture and appliances, which are purchased less frequently as opposed to "convenience" type goods (banks and dry cleaning), which are purchased frequently, all of which are basically town functions. However, the greater variety of goods offered is more than sufficient ⁷¹ to compensate for the distance factor. (see also, B.Berry .)

2. Peter Scott's ⁷² first step in his study was to record all of the functions in each nucleated settlement. Relationships were then examined between the number of functions and functional units through the use of the log-linear pattern, which yielded three main breaks in slope. (Fig. 21).

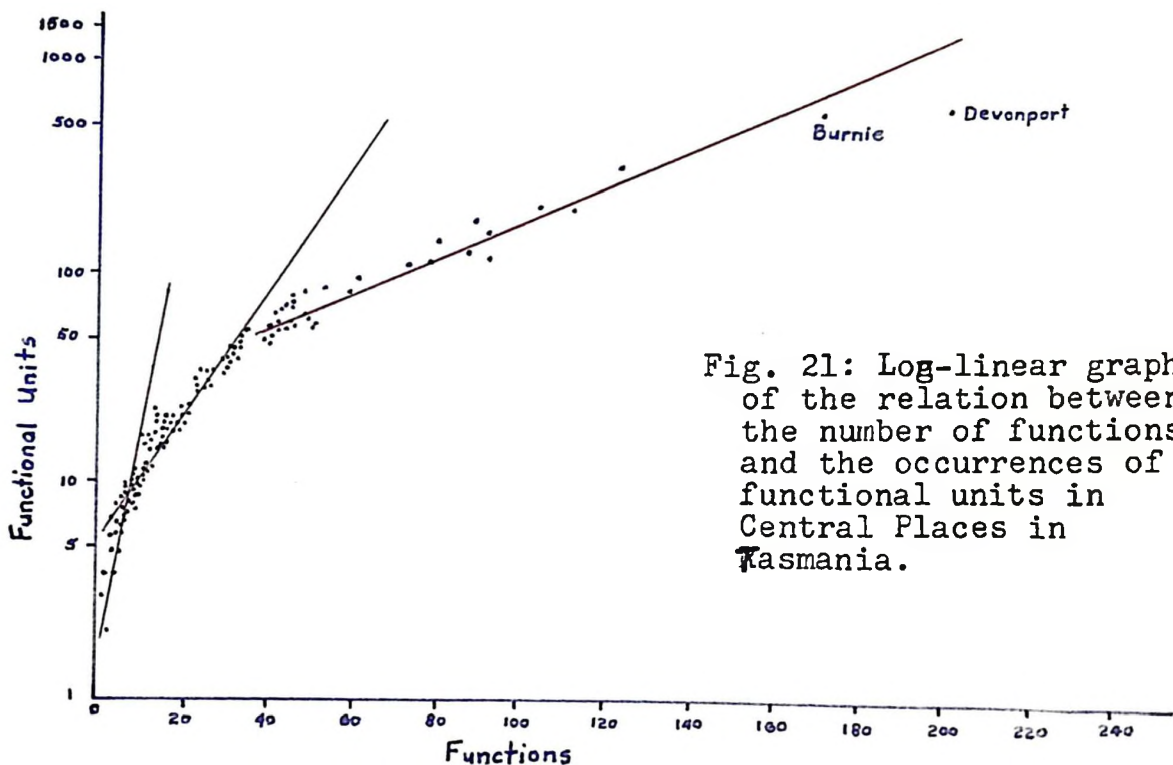


Fig. 21: Log-linear graph of the relation between the number of functions and the occurrences of functional units in Central Places in Tasmania.

71. B. Berry. "The Impact of Expanding Metropolitan Communities upon the Central Place Hierarchy", Annals of the Association of American Geographers, I, (1960), 112-16.

72. P. Scott, "The Hierarchy of Central Places In Tasmania", The Australian Geographer, IX, (1963), 134-48.

The preferable selection of functions and functional units over functions and population was embodied in two reasons: 1) Census figures were incomplete and unlisted for places under 750 population; 2) because central places of each class are held to possess discrete groups of functions, it was considered desirable to attempt a definition of hierarchy primarily on the basis of function; further a comparison of the coefficients of correlation illustrate the inadequacy of a population: function ratio:

- a) functions and functional units - +0.94
- b) population and functional units - +0.81
- c) population and functions - +0.71

The factor analysis method used by Berry and Mayer⁷³ required resources unavailable to Professor Scott, thus forcing him to define functions characteristic of a class center, as those which are common to at least 3/4 of the centers.

Scott noted also (Fig. 21), that the third regime appears to fall fairly clearly into two subgroups, suggesting that if it were not for a distinct break between villages (2nd regime) and towns (3rd regime), the lower cluster of towns together with the upper cluster of villages might constitute another separate regime - this fact is further exemplified in (Fig. 22). Further evidence is interpreted as an indication that major villages are advancing toward the status of a minor town - as yet, they lack the banking, professional, wholesale, and administrative functions characteristic of minor towns.

73. B. Berry and H. Mayer, "Comparative Studies of Central Place Systems", Geographical Branch, U. S. Office of Naval Research, NONR 2121-18, NR 389-126, (Feb. 1962).

Nevertheless, the town group is divided between towns and minor towns. Too, Burnie and Devonport, functionally and population ways, are both beyond the scope of towns, yet too small to be classified as cities - thus the division of major towns.

Table X illustrates the classification established in Tasmania

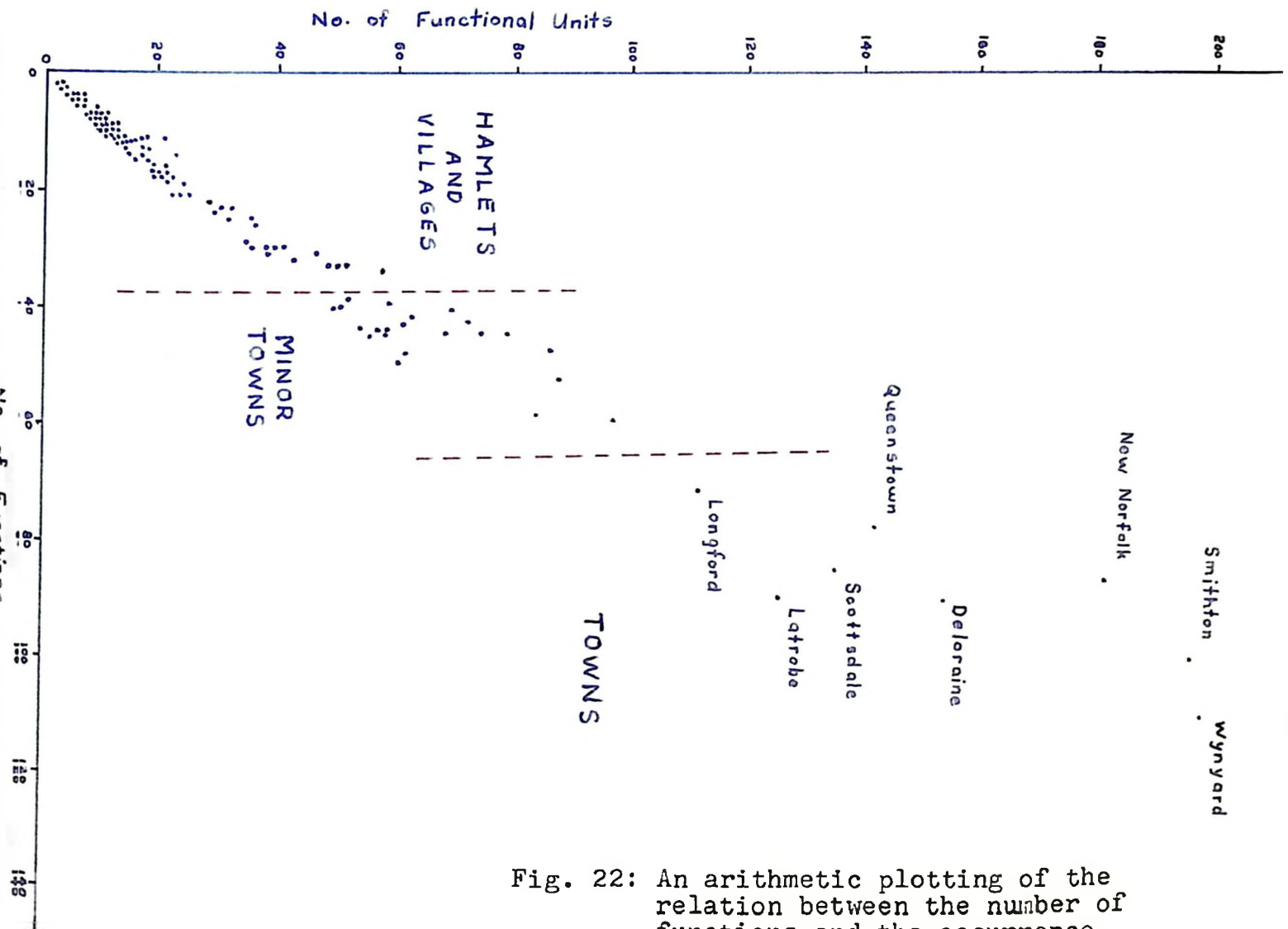


Fig. 22: An arithmetic plotting of the relation between the number of functions and the occurrence of the number of functional units in Tasmania.

Class	Distance (mi.)	No. of Centers	Population
City	158	2	86,325
Major Town	90	2	13,635
Town	45	9	3,250
Minor Town	26 (21) [*] (21) ^{**}	20	1,100 (2,515) [13,850]
Village	9 (10) [21]	171	325 (400) [5,080]
Hamlet	(5-6) 6 (4-6)	191	120

Table X: * Figures in round brackets denote the results obtained from the study J. Brush (page 56).

** The statistics in square brackets are derived from the study by H. Bracey (page 56).

Generally, there is very little similarity between the three studies compared in Table X, concerning population levels. It may be noted that Tasmanian populations are more closely aligned to Wisconsin centers than English centers. A partial explanation may be significant due to the temporal element. English centers being older have a larger concentration than Wisconsin centers while a time lag in the adoption of technological advances has kept Tasmanian centers slightly smaller than those in Wisconsin. Greater similarities are observed to obtain between inter-center distances of the 3 studies. The two lowest orders in each of the 3 works complement one another. The third lowest order though, shows Tasmania centers to be somewhat further removed than the corresponding centers in Brush's and Bracey's studies. Scott accounts for this difference by the irregular physical features and the inclusion of much empty space.

The most prominent irregularity to appear in Table X is the overwhelming number of villages. Scott attributes

this too, to the broken nature of the country, a prevalence of intensive farming and subsequently the tendency for some town functions to become dispersed. This idea bears some support from Bracey⁷⁴ in the form of generally increased mobility among the populace on the one hand, but as yet, much immobility among country housewives on the other. Many individuals from larger centers now seek solitude and relaxation in country surroundings on holidays or weekends, thereby increasing the trade in the village shop. Further, because of increased prosperity and easy transit systems (public or private), greater numbers of people are taking up residence in the countryside, consequently increasing the profits of the village shopkeeper. Unlike her American counterpart, the English housewife does not have her own means of transportation and so, she is forced to patronize the local village shops.

I am assuming here, that the differences between the Tasmanian and American Societies is greater than the differences between the Tasmanian and English societies, such that the significance of Bracey's statements is not to be doubted, rather the degree of their significance has yet to be determined.

3. A third study is a model of the urban hierarchy, developed by Beckmann⁷⁵ on the basis of two assumptions:

- 1) the size of a city is proportional to the area it serves
- 2) cities of orders higher than the lowest have a fixed number of satellite cities of the next lowest order.

The first layers of cities perform the most elementary

74. H. Bracey, "English Central Villages", Proceedings of the I.G.U. Symposium in Urban Geography, (Lund, (1960)), 178-79.

75. M. Beckmann, "City Hierarchies and the Distribution of City Size", Economic Geography and Cultural Change, VI, (1958) 243-48.

of production and distribution functions; i.e. their market distance is determined by the maximum distance tolerable to the rural population it serves. A lowest level of central places is super-imposed on the basic layer so that the size of the city is proportional to the rural population with its trade area. Through mathematical manipulation Beckmann illustrates how the empirical rank-size rule, as observed by Zipf and elaborated by Vining (pages 51-54), is compatible with central place theory's hierarchies of market areas and their central cities as developed by L^osch and other location theorists.

4. We have already observed that the most strenuous opposition to Central Place Theory has come from the Rank Size Rule as purported by Vining. Too, we have noted that there is some doubt that consistency prevails in the Rule's proposals. Nevertheless, the contradictory nature of these two explanations was first questioned by Martin Beckmann who suggested that they were co-existent through manipulation of his mathematical expression. Berry et al made a similar observation in the study previously reviewed and it was from this research that Berry and Barnum⁷⁶ decided to test the validity of this notion.

It was hypothesized that if a small, relatively homogeneous subregion is studied, the existence of an hierarchy of urban centers would be most apparent but in larger areas where heterogeneity is greater, inter and intra area differences combine to create a continuum.

76. B. Berry and H. Barnum, "Aggregate Relations and Elemental components of Central Place Systems," Journal of Regional Science, IV, (1962), 35-68.

11
In any direct factor analysis of an incidence matrix, the first pair of components always represent a general size factor. If the theoretical postulate that levels of centers are a function of the grouping of certain central functions is valid, then the preparation of an incidence matrix X in any area and the application of direct factor analysis to X, should then extract the effect of the continuum on the first pair of components. Subsequently, if there is an hierarchy, the remainder of the components should identify the appropriate classes of centers and functions as interaction effects in a series of group factors.

The result was as expected - the first pair of components identified a continuum of centers on the basis of size, and a continuum of functions on the basis of ubiquity.

Since only sixty per cent of the total number of incidences are accounted for, there must be other reasons for the patterns formed by incidences of the functions in centers. After eliminating the effects of size and ubiquity variations from X, it can be hypothesized that subsequent components represent interaction terms.

The first interaction effect indicates two groups of centers such that if they are ranked on the basis of their correlations with the first interaction term, a group of six cities emerges with high positive correlations - each has more than 55 functions. The second group comprises 20 villages with high negative correlations - each has between 10 and 25 functions.

Similarly, there are two groups of functions indicating that at least 8 have very high negative correlations and all representative of village functions; while there are 50 city functions with medium to high positive correlations.

A third group of centers and functions is recognized by the second interaction term which show high negative correlations characterizing towns with between 25 and 50 central functions.

Centers and functions with a high positive correlation with this second interaction term appear with the greatest disarray from price scaling. In addition, the other five components being concerned with "fill in" activities, indicate that cities and towns perform village functions and that cities perform town functions. (Fig. 23)

The same technique was used in South Dakota with very similar results: the first component comprised a size factor for centers and a ubiquity factor for functions. The next interaction term was again a bipolar city-village factor, followed by the town group factors. Following were the fill in and disarray identifications.

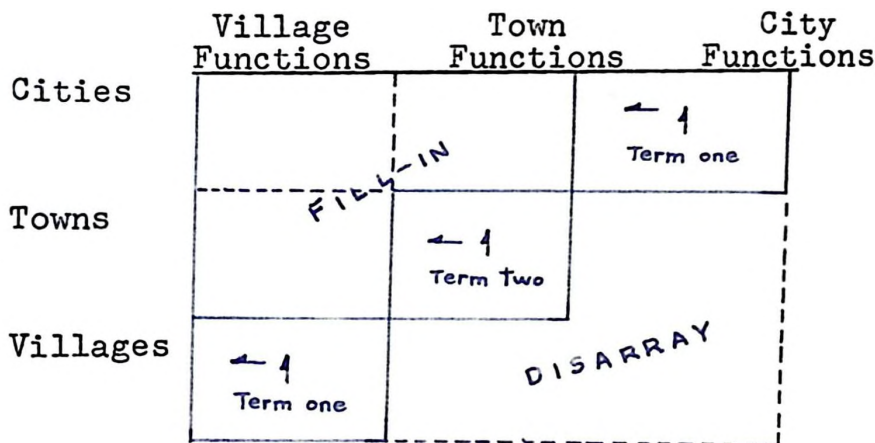


Fig. 23: Nature of the Hierarchy identified by the first two Interaction Terms.

Thus, through the use of factor analysis, Berry and Barnum have provided considerable evidence to support their suggestion for the independent existence of both a continuum and an hierarchy.

IX. CONCLUSION:

While we are able to appreciate and recognize the importance of many of the studies concerned with Central Place Theory, particularly in that they have made the original model conform more appreciably to the real world situation, there are yet, many questions and inadequacies which have not received satisfactory consideration.

Primarily, "How does one assess the degree of reliability from a comparison of different studies?" In that they are designed to study the same variable through the aid of identical techniques, one would expect the conclusions rendered from a comparison to be highly reliable; e.g. comparisons were made here (pages 41-46), between the studies of Thomas and Stafford. But what significance can we attach to a comparison between studies that are purposely intended to measure the same variable, but which use individually different methods; e.g. an attempt to list and compare the results of Brush, Bracey, and Scott was carried out on pages 68-69; each used a different set of criteria in making his calculations. The initial step would be to critically examine and estimate the amount of success engendered by each of the studies. But even given an assurance that each of the methods produced a significant index of the variable under consideration, would we be justified in anticipating corresponding results, (a margin of error is naturally expected), or should we attribute similar findings to coincidence? After all, in the first example, the margin of error was kept constant through the adoption of the same method. In the second example, different factors were free to unite in any combination and influence the final results. Thus an

assurance of the same degree of success through the use of various techniques cannot be expected and any comparison founded between such studies should not be evaluated too highly. This is not to imply that such comparative studies are meaningless, rather it emphasizes the need for more efficient techniques and greater standardization for the compilation of more accurate and precise conclusions.

The problem of scale once again becomes a dominant factor in the consideration of any comparative study. Scott for example, included all of the central places in Tasmania within his sphere of investigation (395 places), while Berry and Garrison used only a portion of Snohomish County (33 places). This is a problem long acknowledged; too little data in a study or too small a sample does not yield an adequate measure of pertinent information for the purposes of problem solving, while on the other hand, an excessive amount of material or too large a sample is liable to camouflage the most desirable results leading to a misinterpretation; Surely, with two such widely varying regions, something is lost in one or the other methods;

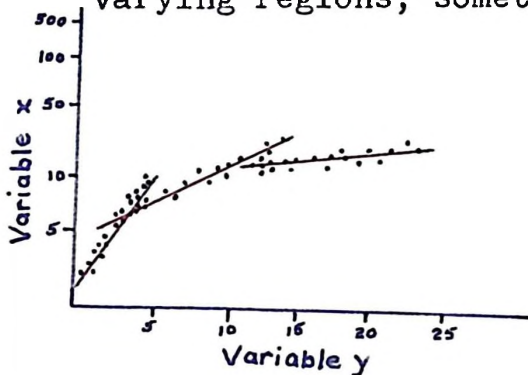


Fig. 24A

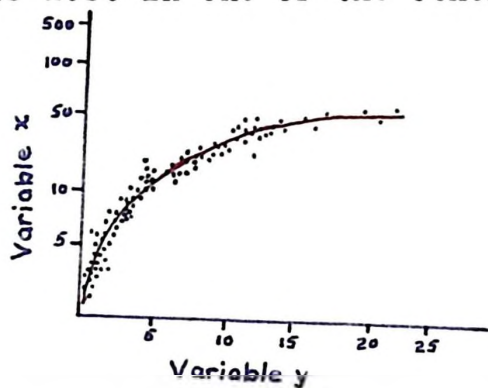


Fig. 24B

✖ Neither of the scatters has any statistical significance. They are merely representations (purely hypothetical), offered to illustrate the possibility of separate regimes (A), coalescing to form a relatively smooth curve with an over representation of data, (B).

e.g. in plotting two variables against each other (population and number of functions in Snohomish County, and number of functions against the number of functional units in Tasmania), distinct breaks (Fig. 24A) would be more readily discernable in the former than the latter where the increased number of observations would tend to occupy and fill in the gaps thus presenting a more uniform curve, (Fig. 24B). On the other hand, too few observations might well fail to produce a significant trend. It would appear from Scott's own illustration (page 66), that the number of centers used is fast approaching its maximum limit.

To what extent is time to be considered a relevant determinant in the spatial distribution of centers? There are some ⁷⁷ who postulate that the only model or theory capable of providing an adequate simulation of the real structure in the world is one which takes into consideration the complex temporal patterns between changing functions and changing locational influences.

Dickinson ⁷⁸ however, found that the majority of the present towns and market settlements, in Germany, were in existence by the end of the Middle Ages:

"The basic spacing of urban settlements arose, therefore, in this period. The few towns founded subsequently, were court towns and places for religious and political refuges. But these introduce quite minor alterations in the medieval distribution that persisted with alteration a hundred years ago."

77. J. Marshall, "Model and Reality In Central Place Studies", The Professional Geographer, XVI, No.1, (Jan. 1964), 5-8 - "Much work has to be done before the existence of a central place hierarchy can be explained truly, and we submit that this work lies in historical, empirical, geography"(7-8).
78. R. Dickinson, City and Region, Routledge and Kegan Paul Ltd., (London, (1964)), 89.

Further, Thomas⁷⁹ tested the significance of the hypothesis that the distance separating a sample city and its nearest neighbour of the same population-size is a function of the population-size of the sample city, which is stable through time with the aid of simple correlation coefficients. The test results proved to be statistically significant and it was further observed that the population-size-distance relationships had remained stable over a period of 50 years (1900-1950), a period of great technological advancement). A reformulation of the hypothesis stated that centers would be more closely associated with, and at a nearer distance to a larger population center than to a center of the same size. These results proved to be more significant than the first set, and they too, showed that stability had occurred.

Complementing the results of this investigation was a study by Morrill⁸⁰ in which he observed that some location decisions, ^{once they} had been chosen, ~~they~~ were relatively stable. He stated also that early location decisions (railways, roads, etc.) had a strong effect upon later development.

To refer once again to the comparative study of Brush and Bracey⁸¹ the only really significant difference is in the class population size, an immediate result of the longer occupation in England than Wisconsin.

79. E. Thomas, "Stability of Distance - Population-Size Relationships," Proceedings of the I.G.U. Symposium in Urban Geography, (Lund, (1960)), 18-29.
80. R. Morrill, "The Development of Spatial Distributions of Towns in Sweden: An Historical-Predictive Approach", The Annals of the Association of American Geographers, LIII, No.1, (Mar. 1963), 1-14.
81. J. Brush and H. Bracey, "The Hierarchy of Central Places in Southwestern Wisconsin and Southern England," Geographical Review, XLV, (1955), 559-69.

Is time to be considered as an appropriate value only in the predictive approach? ^{for example,} e.g. through a study of past patterns of pioneer development, new policy formulations may be of great importance with respect to the development of undeveloped areas. However, there appears to be little effect upon communities once they have been established; i.e. there is little change in the spatial arrangement over time, even though each individual center is in a continual state of flux. The concept of an hierarchy is to be perceived as a state or condition, inherent in which, there is a great degree of flexibility, such that, as significant changes occur in one center, the impact is absorbed by the entire system through a sort of filtering down process.

However, when we speak of the growth and activities of a center, we invariably infer its development. It is through the use of this term, that the important role of the element time is suggested. ⁸² It is not possible to study a spatial process in isolation since the present pattern is a result of a long interplay of forces and therefore the historical process is of great importance. In our industrial complexes to-day it is often a fact overlooked, that our society had its beginnings in a rural, agrarian structure. Since then, increases in births over deaths, technological advances, improved transportation facilities, and early locational decisions all influenced the patterns of growth. The last great revolutionary stage was brought about by the railway era in the mid Nineteenth Century at which time considerable change in city distribution

82. J. Blaut, "Space and Process", Professional Geographer, XIII, (1961), 4-5.

patterns did take place. At this time centers that gained importance through the influence of rail routes increased their stability so that they have remained as the focal points of a region. The point that I have been labouring here, is simply that, in their primary growth periods, towns are extremely susceptible to any new changes but once the major routes of movement have been located and a substantial base for the center effected, it will no longer be as vulnerable to these changes. This could be used to explain the degree of stability in Thomas' study.⁸³ Had the amount of technological change that occurred between 1900-1950 taken place one hundred years earlier, there is good cause to doubt that stability would have persisted.

The development of an urban pattern, then, takes place over time within a changing economic and social setting and subject to spatial controls aiming at efficient location. Thus, the functional interpretation of spatial distributions must be dynamic, taking into consideration the economic and technological changes. Even though Central Place Theory has undergone a significant transformation in recent years with the relaxation of specific constraints, which tended to limit the applicability of the Theory, through the efforts of Brian Berry and his colleagues, the temporal element has been left unexamined. This should not be so. The task of the geographer is to elicit a description and explanation of the presence of certain phenomena over the surface of the Earth in terms of their distributions, and not only their spatial distributions, for these

83. E. Thomas, "Stability of Distance-Population-Size Relationships", "Proceedings of the I.G.U. Symposium in Urban Geography", [Lund, (1960)] , 18-29.

phenomena do not just occur, they develop over a period of time. Another reason⁸⁴ for the inclusion of the historical process is that human evaluation of space changes through time such that our ability to cross space changes greatly with the adoption of new modes of transportation.

Thus, although the hierarchy of centers has been shown to exist at the elemental level, the problem remains to be quite complex. One can only hope that continuing research and more sophisticated models will eventually result in our increased knowledge of locational theory for cities, i.e. the spatial organization of society.

84. R. Morrill, "Migration and the Spread and Growth of Urban Settlement", Lund Studies in Geography, Series B, No. 26, [Lund, (1965)] , 10.

E. A METHOD TO DETERMINE THE EXTENT TO WHICH A CENTER SERVES THE PEOPLE SURROUNDING IT.

I. GENERAL:

As we have already observed, various methods have been employed by geographers to assess the importance of a place, using as their definition, that suggested by Walter Christaller; namely, the excess of importance derived from the difference between the total importance of the place and importance of the place itself, or, the degree to which a place serves as a distribution center for the dispersed population. Some studies have attacked the problem by defining the trade area, but this calls for demarcation lines of an exacting nature and assumes that the segment of the population thereby bounded will conform to the concept of distance minimization giving no consideration to spatial preferences, which, and there will probably be little argument here, increase as society itself adopts a more affluent cognizance. This remains to be the greatest defect in any of the methods whether they recognize the relative importance of retail sales, transportation densities, functional complexities, telephone orders, etc.

Such a consideration could possibly help to shed more light on the influence exerted by improved transportation media and offer some insight into the decline of hamlets, their present function and future prospects.

If one accepts the postulate of Ullman and Harris that there are, in the extreme, three different kinds of centers, (Central Places, Transportation and Industrial Centers, Resort and Mining Towns), and that most centers display to some degree

a combination of these activities, then a method for explaining the locational theory of centers should be comprised of an index which integrates the most relevant characteristics of each of these types. The most valuable function for estimating the importance of a Central Place is the extent to which it is successful in providing for its complementary region.

The following model suggests a method of assessing the relative importance of a place through an investigation of its value to the surrounding population, by taking into account spatial characteristics and population densities.

II. STUDY AREA:

Exhibiting a bias in its functional structure to satisfy the demands and needs of a rural clientel, the ideal location for a Central Place study would be one which displays as little relief as possible in order to accommodate in the most efficient manner, a regular dispersal of inhabitants over the area. An increased amount of relief inhibits the degree to which transportation facilities are developed in an area and tends to encourage the development of settlements in pockets or in linear patterns along valley basins. On the other hand, the less the relief, the more development favours a regular pattern of occupance, accompanied by more favourably dispersed and developed transport routes.

Since the importance of these centers depends upon the patronization of a dispersed, rural population, the study area should exhibit a predominantly agricultural population; e.g. Haldimand County, Ontario.

III. DATA SOURCES:

(i) Direct observation and Topographic Maps are to be used to determine straight line distances from one center to another and the location of each individual in the sample to the centers of first and second choice in their transactions.

Each center, irregardless of size is to be visited and the number and name of each function represented, recorded.

(ii) Questionnaire: The structure of the questionnaire should be presented below. Haldimand County, not having a large population could be reliably sampled from a total of 300. None of the urban residents would be included in the sample. A stratified random sample of the rural population would be taken from those individuals living outside the city limits whose main source of income derives from agricultural activities. These activities are to be directly associated with the production of agricultural goods; i.e. this does not include machinery sales and repair, the selling of pesticides, co-op. storage, etc.

Accompanying the questionnaire should be a short explanation for the purpose of the study and a particular notation directed to each of the individuals that his signature is not necessary as an added note of assurance to him that the information will not be publicly released. Organization of the questionnaires can be administered later through the use of a master copy upon which the number of the questionnaire is adjacent to the address of its owner. In this manner, the results can be located and tabulated efficiently.

QUESTIONNAIRE

Age _____ Number of Dependents _____ Religion _____

Education _____

Place of Birth _____ Net Income _____

1. Name the closest city, town or village _____ .

2. Name the second closest city, town, or village _____ .

3. How many miles of paved highway are there to
(i) closest city, town or village _____ ?
(ii) second closest city, town or village _____ ?

4. How many miles of unpaved highway are there to the
(i) closest city, town or village _____ ?
(ii) second closest city, town or village _____ ?

5. Name the center where you do the most of your business over
the period of one year _____. Approximately \$ _____. .

6. Name the center where you do the second greatest amount of
business in one year _____. Approximately \$ _____. .

7. Why do you do business at the center in question 6 rather
than the center in question 5? _____

8. What form of transportation do you use _____ ?

✕ 9.(a) Name the center where you usually purchase your food _____

(b) How many times do you visit this place for food; per week _____
per month _____, per year _____? (Fill in the blank which
you can estimate most easily).

(c) What is the approximate cost to you for food; per week _____
per month _____, per year _____? (Fill in the blank
which you can estimate most easily).

Questions 10-20 follow the same form as question 9

for the following items: Clothing, Furniture, Dry Cleaning,

Auto Repairs, Bank, Doctor, Dentist, Footwear, Hardware,

Amusement, Barber or Beauty Shop

✕. The items concerned in questions 9-20 are derived from the
grouping of functions explained below in the method. I have
inserted these activities for illustrative purposes only,
although they could be the most pertinent.

IV. METHOD:

- (i) Locate all of the settlements in the study area on a map of the County of Haldimand. Note should be made of each center and population statistics for the latest census common to all.
- (ii) From the lists of functions gathered through Direct Observation, rank them according to the method of Direct Factor Analysis. These then could be assigned in groups to be representative functions of cities, towns and villages. From within this ranking, select 12 items (4 from each category), to be used on the questionnaire above in questions 9 - 20 inclusive.
- (iii) With the return of the questionnaires, a straight line map could be constructed to illustrate the purchasing pattern of the sample population. A different map would be made for each of the items questioned and one for general business transactions - question No. 5. To emphasize any contrast, a blue line could be used to link the individual's location to the center of purchase, if that center happened to be the closest, and a red line if the purchase was acquired at some center other than the closest. By the closest center, I am referring to that nearest center which offers the specific commodity under investigation.

With a knowledge of the purchases and deviations from a given closest center it is possible to determine the extent and consistency of the various commodity sales within the center and the support these activities are given by the outside population; i.e. the significance which these goods hold for their respective centers by themselves and in conjunction with other activities.

Multiple Regression Analysis would be the instrument of measurement with the distance travelled acting as the Dependent Variable and the Independent Variables would be:

- (a) number of functions in the most frequented center.
- (b) frequency of purchase in the most frequented center.
- (c) amount of transactions in the most frequented center.
- (d) number of functions in the second most frequented center.
- (e) frequency of purchase in the second most frequented center.
- (f) amount of transaction in the second most frequented center.

(iv) Once the various commodities have been selected, they can be assigned to one of two categories; i.e. Primary Goods (those that require frequent purchasing - food) or Secondary Goods (those that require less frequent purchasing - footwear). The consumer behaviour maps mentioned above could be used to determine any relationships that might possibly exist between these two types of goods and the amount of support and patterns established by the population.

(v) The consumer maps, once complete allow us to approximate the extent of any center's trade area.

(vi) From the information obtained, a reliable test could be conducted to investigate the presence of an hierarchy of places. Once again, the consumer maps and scatter diagrams could be useful tools.

(vii) Each of the personal statistics (age, income, etc.), appearing on the questionnaire, could be used as an independent variable and an examination of their impact upon consumer purchasing patterns investigated. Each would be divided into two or three categories such that the percentage of each in the sample would be proportional to its frequency of occurrences.

(viii) The Arithmetic Mean Center method could be used to determine whether the centers are in their best location with respect to their trade areas.

V. EXPECTATIONS:

- (i) The results from the Regression Analysis would be expected to produce significant correlations.
- (ii) We would expect individuals to travel further for Secondary Goods than for Primary Goods but less frequently.
- (iii) A relatively consistent relationship would be expected to obtain between rural population densities and centers of similar size.
- (iv) An hierarchy of Central Places would be expected and that the people supported and used this hierarchy accordingly would also be expected.
- (v) Different patterns of patronization would similarly be expected to exist among the groupings within income, ethnic groups, etc.
- (vi) Finally, it may be permissible, dependent upon the outcome of the above investigations, to conclude with a few broad generalizations concerning the extent to which a center is established for the purpose of serving its surrounding population.

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