A Reinterpretation of the Rank-Size Rule: Examples From England and the Land of Israel

David Grossman and Michael Sonis
Bar-Ilan University

The existence of a rank-size regularity of rural settlements has been demonstrated by a number of authors. This article argues that the cause of such regularity must be sought in the essential characteristics of rural settlements, particularly their land orientation. Regularity can be presented in the form of a straight line on a semi-logarithmic grid, but most rural areas contain sections above (the head) and below (the tail) the line (the mode). This rule is an approximation of the rank-size regularity that can be illustrated by the relative rate of change between pairs of settlements whose ranks are k and (k + 1) on a logarithmic grid. The low (monotonic) rate of change of the middle (modal) section stands out against the high rate of change of the largest and smallest settlements.

The significance of the shapes of the curves are discussed by analyzing a case from Britain (Cheshire) and from three areas in Israel and the West Bank—Philistia, Ramallah and Hebron. It is shown that the specific shape of the rural rank-size curve can be related to internal forces operating in the study areas. The dominance of the typically rural sector (the mode) is clearly evident in stable rural areas such as Philistia and Ramallah. Unstable areas tend to have very conspicuous tails, while the development of non-farm sectors results in a pronounced head.

The concept of rurality is generally based on Newby's (1979) "occupational community," which implies that rural residents are part of integrated spatial systems where residence and employment coincide. Urbanization, however, has recently changed many of the characteristics formerly associated with rurality, and as a result, it is now argued by sociologists that the distinction between urban and rural societies has been

Geography Research Forum, vol. 9, 1989.

progressively blurred (Pahl, 1966). These findings and others that refer to problems of social changes that have occurred in the countryside are summarized by Philips and Williams (1984) and have widely discussed in several recent books (e.g., Bunce, 1982; Pacione, 1984). The urban-rural dichotomy has not yet, however, been totally obliterated; it has, rather, shifted to the intrarural space where society is described as "split" (Pahl, 1970), "encapsulated," or "polarized" (Newby, 1979).

Some geographers refer to rural settlements as "the lower limb" of the settlement hierarchy (Haggett, 1965; Cowie, 1983), but rural areas are not merely "mini-urban" settlements. This belief was clearly stated by Christaller in his classic work on the subject (1966). This article focuses on the special nature of rural rank-size characteristics that reflect the nature of rurality.

The significance of this issue has been implied in various discussions that focused on spatial structures in rural areas. Saville (1957) presented a number of tables of frequency distribution that were used to analyze the problem arising from the multiplicity of small and declining villages. Johnson (1970) demonstrated this situation in an even more extreme manner in discussing developing countries; this author found that the town to village ratio could be as low as 1:300, i.e., that there were a very large number of settlements in the lowest ranks.

The problem of defining the exact point of division between urban and rural settlements was not ignored by Johnson (1970); both he and Saville (1957) offered detailed discussions of this subject. The concept of rurality also differs from one country to the next, depending partially on prevailing settlement patterns. A useful overview of the variety of approaches taken to resolving this question can be obtained through works published and I.G.U. symposia held on the subject since the 1920s (e.g., Demangeon, 1927; Lefebvre, 1934; Enyedi, 1975).

As previously stated, Pahl (1966) focused attention on the blurring of the rural-urban dichotomy and suggested that it has been replaced by a continuum. This continuum may be the result of the urban "corona" (the unincorporated rural non-farm dwellings) that Hart (1984) identified in the Upper Great Lakes region, but it may take a variety of other forms, such as the conversion of farm villages into non-farm residences, a process which is quite common in Britain.

The existence of various intermediate forms between purely rural and purely urban settlements cannot be ignored. It must be stated, however, that these authors' definition of a rural place is based on the assumption that until fairly recently the urban-rural condition was a dichotomy, rather than a continuum. This assumption is made because the concept of rurality, as will be explained, is based on agrarian principles. It follows from this definition that this study will concentrate attention on conditions

preceding the modern process of converting the urban-rural dichotomy into a continuum.

The existence of a threshold below which the well-known urban rank-size regularity (Auerbach, 1913; Zipf, 1949) does not apply was reported fairly early (Allen, 1954), but a systematic study of rural rank order was not undertaken until the 1960s (Gunawardena, 1964; Haggett, 1965). Subsequent studies (e.g., Unwin, 1981; Sonis and Grossman, 1984) have confirmed that there is a widespread phenomenon of rural rank-size regularity and have helped illustrate this fact within a framework of broad historical and geographical contexts. Such discussions have demonstrated that the rank-size regularity is fairly stable in time, and still exists today.

The rural rank-size empirical regularity is generally recognized as a convex curve on a double-log grid, and its explanation is usually placed within the context of central place theory. Convexity does not necessarily occur only in rural areas, although in many cases it is found where a low level of national integration exists. Skinner (1979) found that when all the eight major regions of China were combined (pooled) in a single graph, the result was a convex curve because none of the major cities "exhibited the centrality needed to integrate a Chinese system of cities." Likewise, Johnson (1977) noted that where communication is impeded by "topography and poor transportation nets," interaction between adjacent systems is low and the settlement system is likely to have a convex line, which may also occur if there is a "discontinuous hierarchy" with "multiple highest order central places."

Another article by this author, based on data from the eighteenth and nineteenth centuries, endeavoured to prove that improved connections between the U.S. and the rest of the world have resulted in converting the convex rank-size line to a log normal configuration (Johnson, 1980). Johnson distinguished, however, between (a) the pooling that occurs when the scale is large and a number of settlement systems are combined; and (b) the partitioning that occurs when the scale is low.

The condition of low scale occurs when the primate centre lies outside the region whose rank-size structure is under discussion. The example quoted by Johnson (1980; based on Paynter's study) is that of the eighteenth-century American colonies whose centre was in Britain. Paynter (1982) referred to this situation as "peripheral;" he developed the thesis that such peripheral conditions give rise to convexity, although he also recognized the impact of pooling under conditions of large scale (i.e., several systems). This author's data, which was based on a detailed study of the Connecticut valley, showed that convexity tended to decrease (in terms of population density and wealth density) as the area developed and industrialized between 1800 and 1850.

This discussion of the relatively small Connecticut valley (72 towns in

1850), which was still largely rural in the early nineteenth century, is closer to the approach taken in this article. It is rather unfortunate that Paynter's data on wealth density are presented only in an aggregate form. If the farm sector had been isolated from the rest, it could possibly have been shown that a close association exists between farming and the shape of the rank-size graph.

Although these authors do not ignore the significance of trade and communication, it is believed that in small-scale, largely rural areas, the explanation does not necessarily lie primarily in core-periphery relationships, but rather in the fact that rural settlements are land-oriented. The emergence of central place functions can serve as a major reason for a bulge in the convex line. This same phenomenon or an even larger one can also be caused, however, by converting rural villages to dormitory settlements or by other processes that alter the traditional agrarian character of rural areas. Such a bulge may gradually expand to approach a log normal linear graph; but the main sector, the typically rural part, will retain its convexity.

The idea that a specific rural rank-size regularity exists was suggested by Gunawardena (1964), and was subsequently presented by several other researchers (e.g., Baker, 1969; Burtchett, 1969; Unwin, 1981). The study by Sonis and Grossman (1984) offers a more recent presentation of rural rank-size regularity, by converting it into a straight line on a semi-logarithmic grid (see Figure 1). This conversion provides a "linear approximation which describes only the main tendency of a much more complicated analytical rank-size dependence."

The analytical expression of the rank-size regularity is given in the form of a rural rank-size rule:

$$P_k = P_1 6^{k-1} \tag{1}$$

where P_k is a population size of the k-th rural settlement, and 6 is the rate of decrease of population size. The interpretation of this rural rank-size rule is:

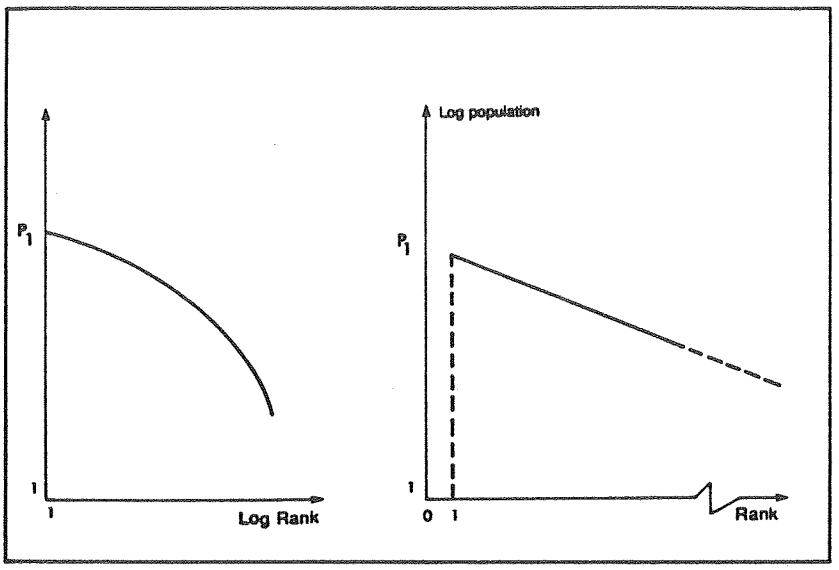
$$P_{K+1}/P_k = 6 \tag{2}$$

i.e., 6 presents the rate of change of the population size independent of rank.

This rural rank-size rule can be considered as an approximation of the actual rural rank-size empirical regularity (see Figure 2). Taking the logarithm from both parts of (2) produces the following:

$$\log P_{k+1} = \log P_k + \log 6. \tag{3}$$

Figure 1.
Double-Logarithmic and Semi-Logarithmic Rank-Size Distribution Curves

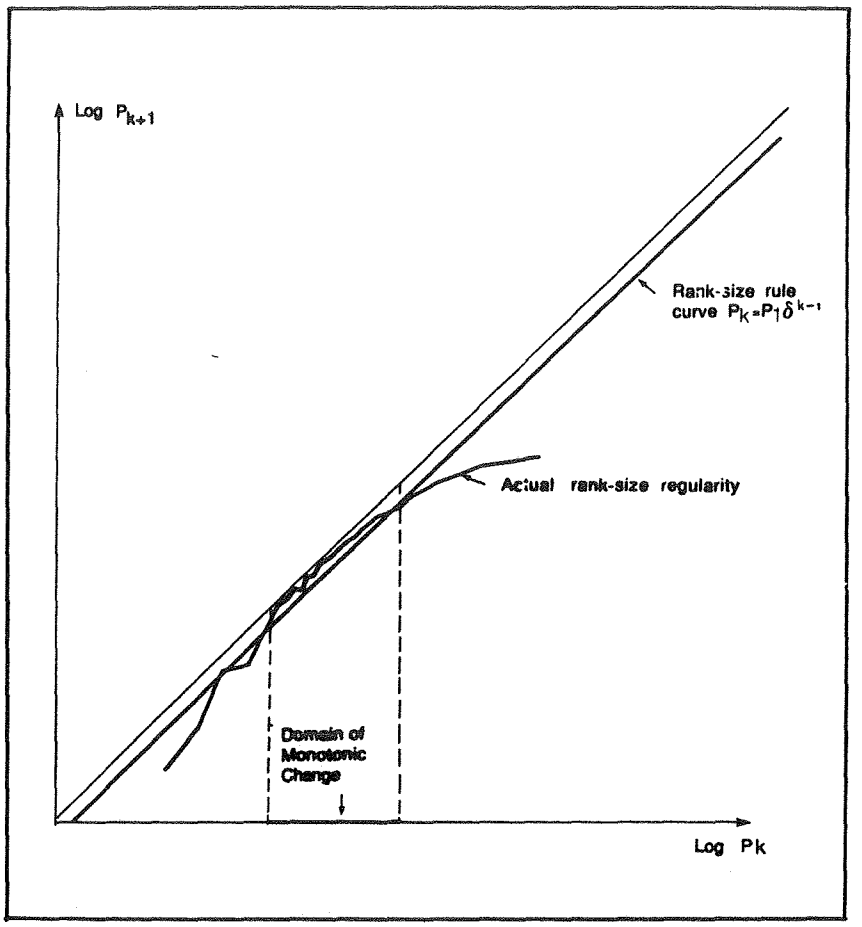


This expression allows the construction of Figure 2 by plotting log P_{k+1} on the Y-axis and log P_k on the X-axis. This changed presentation of empirical rank-size regularity is characterized by the following properties: (1) if $P_{k+1} = P_k$, then the point (log P_{k+1}, log P_k) lies on the 45° straight line; (2) if there is a set of settlements of approximately the same size, then the points (log P_{k+1}, log P_k) will form a short section of a straight line parallel and close to the 45° line. This plotting means that the transition from size P_k to size P_{k+1} is associated with a low rate of change.

It was found empirically that the rank-size curve is divided into three parts—a monotonic one and two non-monotonic ones, as shown by Figure 3. These parts of the schematic curve correspond to situations in which the rate of decrease either depends (in the monotonic section) or does not depend (in the non-monotonic section) on rank k.

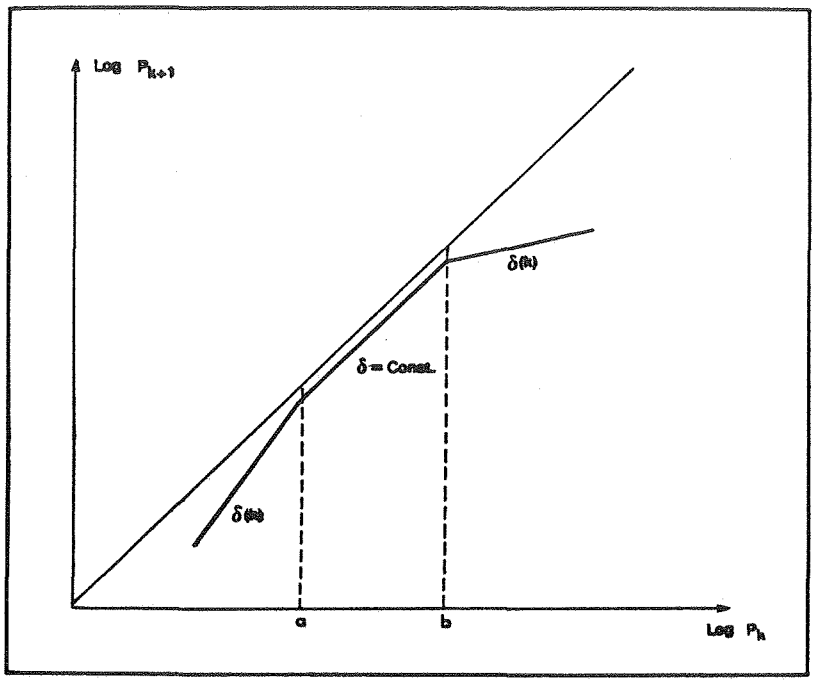
The monotonic section of Figure 3 demonstrates, in essence, that as either upward or downward movement is made along the graph from one village to the next, there is some inhibition that interferes with the line. In the monotonic section, villages seem to be attracted toward each other,

Figure 2.
Actual Rate of Change in Rural Settlement Rank-Size Regularity



while in the non-monotonic ones (i.e., the upper and lower sections) they are pulled away from each other. The section (a, b) in Figure 3 illustrates the monotonic or fairly stable section, while beyond these points there is a greater flux in the system. These sectors of Figure 3 correspond to the head (upper), tail (lower), and middle (modal) parts of the rural rank-size rule (Sonis and Grossman, 1984). The new form of this rule provides a basis for the analytical and graphical presentations of the dynamic changes in rural rank-size regularity.

Figure 3.
Generalized Presentation of Rate of Change in Rank-Size Regularity



Earlier studies (e.g., Johnson, 1980; Paynter, 1982) typically addressed the dynamic transfer from the convex curve to the linear graph on the double-logarithmic grid. The difference between these authors' approach and those of other studies cited is in concentration on the internal dynamics of the rural settlement system, i.e., consideration of changes that occur within the rural rank-size curve to be the result of modifications in the nature of rural living.

On the basis of analyzing the data obtained from Southwestern Cheshire, this study shows that the main reason for stability (i.e., the monotonic transition from one settlement to the next in the middle section) is that rural people are organized in groups (or political units) that depend on land utilization. Such settlements require a relatively even distribution of population, and consequently a relatively even distribution of settlement size.

The distribution of land among communities (as distinct from individuals) is not necessarily egalitarian, but it can be reasonably assumed to be so. Where land has been centrally distributed or its spontaneous evolution is well-recorded as under the "Homestead Act" or in the planned Moshavim in Israel, this equalization principle can be easily documented. Unfortunately, little information exists regarding the evolution of most agrarian systems, and the process must be reconstructed, at best, using scattered data. It is not possible to cover the literature that exists on this subject in the scope of this article, but a quotation from the Orwins' 1967 analysis may help clarify the historical development of such areas. These researchers reported on the parallel arrangement of parishes in the Lincoln Heath and the string of Berkshire parishes west of Wantage, implying that the territorial pattern observed is rooted in ancient organization and is the result of careful land allocation: "These examples illustrate . . . the wisdom . . . of those who first partitioned the land amongst the village communities, and many like them are to be found under similar topographic conditions." The authors conclude that "Although the growth of population in a thousand years has led to a great extension of the cultivated area, . . . nothing has happened . . . to suggest how the planning of the countryside for agriculture, as it was done long before the Norman Conquest, could have been bettered" (Orwin and Orwin, 1967).

Roberts (1977) was more cautious, observing that "it is now virtuously impossible to appraise soils through Anglo-Saxon eyes." However, he then uses the same examples mentioned by the Orwins and adds a few others, to illustrate the principles of land allocation that lead to the egalitarian distribution of land among communities. Roberts employs six generalized models to illustrate the types of terrain likely to affect parish (township) boundaries that mark the extent of community lands.

Even if it can be demonstrated that an egalitarian principle has existed, however, it is known that historical processes have substantially altered this initial equality (Roberts, 1977; the discussion of township splitting in Taylor, 1970; Dodgshon, 1980). The main rationality behind the argument in favor of egalitarian land allocation is, however, that under conditions of near subsistence (i.e., outlets for surpluses were limited), vacant land was taken up or redivided according to needs, so that land did not remain vacant for long and its size was proportional to the number of the working hands in the community. This principle forms the basis for the Boserupian explanation of the relationship between population pressure and cultivation systems (Boserup, 1965, 1981), but it also provides a useful general explanation for the widespread practices of communal cultivation, whose most developed form is the *Open Field* in Northern Europe. The *Musha'* system of the Arab Middle East (Granovsky, 1949; Baer, 1971) or the com-

munal land tenure systems of Tropical Africa (e.g., Jones, 1949) follow the same general principles, although they differ by specific detail. Dodgshon's thesis (1980), which links the Open Field to feudalism, does not necessarily conflict with this explanation. The feudal system could have altered the egaliterian system by creating new communities, but did not necessarily do so; the peasant's semi-subsistence economy was not substantially altered by the feudal economy.

The study of the evolution of territorial units suggests that feudal modifications of boundaries were not insignificant, but it is interesting to note Sylvester's findings, because he conducted substantial research on this issue in Cheshire (Sylvester, 1957, 1960, 1967). This author defined a township as "the community and its land" (1969) and considered it of pre-Norman times (1967). Similar observations concerning the communal significance of the parish can be found in the works of Webb (1906), Tate (1969), and Newby (1977).

The problem of defining territorial units in eastern England, where the villages are usually more compact, is less severe than in the western part of the country. Roberts (1977, 1982, 1983) offers a method for classifying villages by form, suggesting that this approach can also be used for reconstructing processes of change. Many Cheshire settlements fall into this author's composite or polyfocal class (Roberts, 1982; see also Taylor, 1983), but many defy classification on the basis of form. The complexity of settlement forms in western England may partially account for using Chapman (1953) and Sylvester's (1967) territorial (township) based classification. The dominant theme of these studies is that field patterns are closely related to settlement patterns; this possible correlation stimulated early geographical research (e.g., Meitzen, 1895; Demangeon, 1947) as well as more recent works. Uhlig (1961) argued that in northeastern Europe, a relationship exists between settlement forms in regions experiencing colonization and the shape of the fields found in such locations. A similar relationship has been pointed out by others, most notably Dodgshon (1980).

These possible relationships cannot be treated in sufficient depth in this study. Generalizations are of limited value because the impact of the local culture on the specific shape of the field-settlement relationships must be considered. Some elements of the field-settlement relationship, however, are illustrated by this research. The crucial question is to what extent settlements can be defined on the basis of their land. Although this question may be relatively minor in well-established rural areas, whose territories have been stabilized for many generations, it can become a major problem in areas undergoing change.

The analysis of the relationships associated with colonization is the major problem of this study, which began with an analysis of Southwestern

Cheshire, an area of stable settlement. A number of maps, beginning with the Tithe survey of the 1840s, were consulted to facilitate the analysis.

The Southwestern Cheshire Study

The data used for plotting the rank-size graphs refer to the 27 civil parishes defined in 1981 (see Figure 4); these parishes were equivalent to townships as they were defined in 1851 (although in 1851 the actual number was 26 because one township registered no population). A careful study of maps and other available records suggests that no territorial modification that would affect the interpretation of the data took place during the intervening period. In addition to census records, however, use was also made of rate valuation records, (listings in Kelly's Directory of 1939), and of Ministry of Agriculture, Fisheries, and Food (MAFF) data for the same territorial units. Map analysis has provided another means of attempting to identify settlement units.

The significance of farming and territoriality led to attempts to isolate elements that are directly responsible for the uniqueness of the rank-size function. This effort resulted in several rank-size exercises that are discussed in the following sections.

Farmstead Clusters

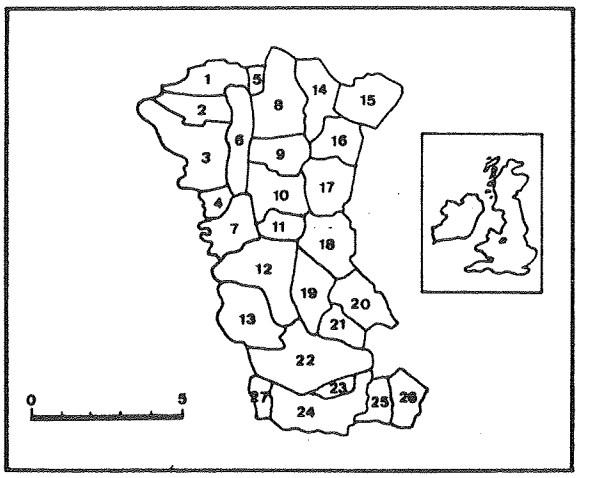
The first and simplest exercise involved the separation of farmsteads or clusters of farmsteads from other structures and then treating them as discrete settlements. Farmsteads were defined as structures located 250 meters from the nearest neighboring structure. Figure 5 shows the rank-size distribution of these clusters on a semi-logarithmic grid. This analysis does not share the principle underlying the rest of this study—that the parish (township) area represents the real settlement. This specific definition makes contiguous farmsteads settlement units, although the definition is still made within the context of dependence on land.

The results, plotted on a rank-size curve, point to the presence of a clear single-farmstead mode for all periods under study. The maximum number of farmsteads in a single cluster was 9 for 1851; this maximum was only four in 1984. It is clear that clusters diminished in size during the past century. The problem of defining the term farm, however, could have affected the results obtained; in 1851, the term was restricted to persons with at least 3 acres of land, while data for more recent dates included some small landholders who had smaller farms, although the mean farm size was actually larger. The tendency, however, for farms to be located outside the village or at its periphery was clearly in evidence (compare with Mills,

Figure 4.
The Southwestern Cheshire Study Area

LEGEND
(Civil Parishes)

1 - Churton by Aldford
2 - Churton by Farndon
3 - Farndon
4 - Crewe by Farndon
5 - Edgerley
6 - Kings Marsh
7 - Caldecott
8 - Coddington
9 - Barton
10- Stretton
11- Grafton
12- Church Shocklach
13- Shocklach Oviatt
14- Aldersey
15- Chowley
16- Clutton
17- Carden
18- Tilston
19- Horton
20- Overton
21- Chorlton
22- Cuddington by Malpas
23- Newton by Malpas
24- Oldcastle
25- Stockton
26- Wychough
27- Threapwood



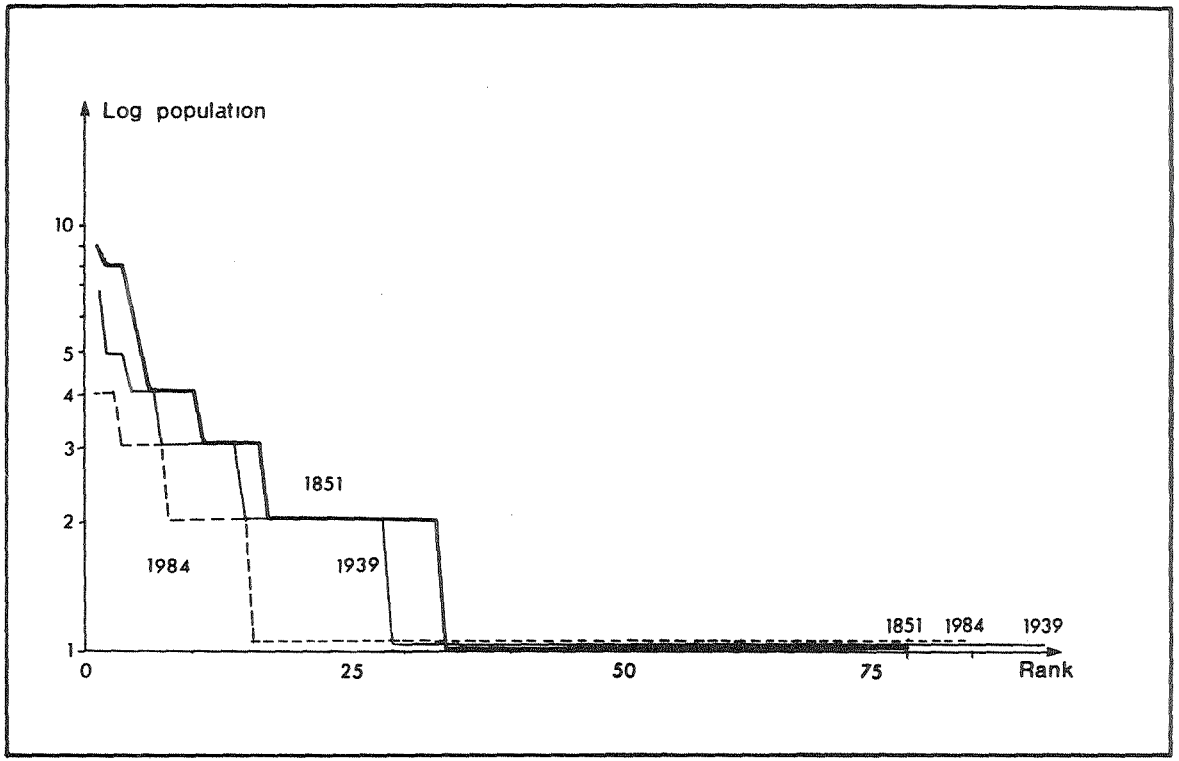


Figure 5.
Southwestern Cheshire—1984 Farmstead Clusters, Rank-Size Distribution

1959; Gleave, 1962). Single farmsteads accounted for 43 out of a total of 149 in 1851; 71 out of 152 in 1939; and 68 out of 107 in 1984. If farmsteads are equated with rural settlements, these results provide an important method for illustrating the relationship between the rural rank-size rule and the dependence on land. The main problem is that all non-farm structures were deliberately excluded, so the approach may only fit the most extreme definition of rurality.

Contiguous Residential Areas

The non-farm, built-up village areas were included in another rank-size exercise, conducted on the same 27 civil parishes. This exercise, unlike all the others, was not based on the land principles, but considered the possible impact of the alternative definition of settlement: contiguous residential units that included an entire population. Definition on this basis proved to be difficult, involving among other things, identification of the boundary between clusters of buildings and the decision regarding the settlement core in an area with settlements that are typically amorphous. The nature of the census data available made it impossible to distinguish units smaller than households. The settlement core was defined by the existence of a central function (such as a church, chapel, shop, school, or public house); the periphery was defined by assigning outlying farmsteads or cottages to the nearest cores located along main roads.

The main finding in this regard was that the typical rural rank-size curve was absent or poorly developed, particularly for 1981. The line rose sharply from one (1 case in 1851 and 2 cases in 1981) to 100 households. Above this level, it rose steeply (2 cases) up to 538 in 1981; in 1851, there were only 3 clusters at approximately this level, and none above it. The more even distribution of household clusters in 1851 is consistent with the greater degree of self-sufficiency at that time. The absence of a clearly defined mode in both dates fits in well with the hypothesis that the rural rule is explained by land rather than by contiguity of residential area, but these results cannot be regarded as conclusive because of the problems of definition. The polarization process that emerges from these results has been discussed in detail in other studies (Grossman, 1985).

Population Density

All other definitions for which the rank-size structure was examined were based on the territorial unit (i.e., civil parish). Population densities provided a crude measure of the dependence on such territories. The re-

sulting rank-size distribution showed that they had a more pronounced mode than one based on absolute population.

A better way of illustrating the impact of land on the curve was by separately plotting the distribution of households dependent on farming; this was done in two additional exercises.

Farm-Based Population

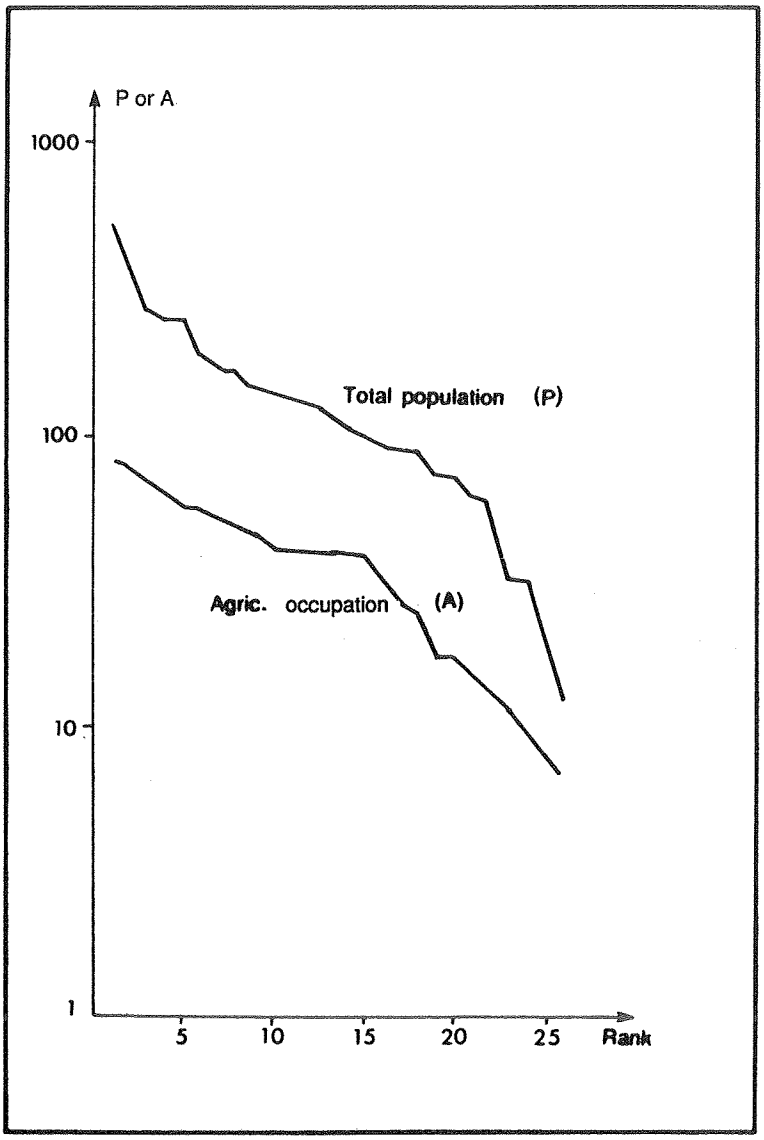
The farm-based population comprised farmers, farm workers, and farmers' domestic servants of both sexes. The 1851 census figures reveal that the variability among townships in the total number of the farm-based population was low, i.e., that the farm population was fairly evenly distributed (see Figure 6). The only exceptions to this result were the smallest units, which were likely to be seats of local squires who were not listed in the census as farmers.

This low variability of distribution is particularly outstanding when attention is focused on larger settlements. No clear break-point was encountered in 1851, indicating the absence of major differences between large and small settlements where the farm-based population was concerned. This uniformity stands out clearly when the farm-based population is plotted against the total number of households. The steep rise in this line above the level of 50 households implies that it is at this level that craftsmen, shopowners, and other non-farmers predominate over the farmer population.

The stability of the number of farm units is impressive. The distribution of full-time farmers and managers for 1978 closely resembled that of 1851 even on the level of the single village: the total number was 151 in 1851 and 150 in 1978. But if the total farm population is considered, a drastically different picture emerges. The farmers' households of the 1970s and the 1980s do not include the traditional occupations of cow man, dairy maid, footman, waggoner, or any other specialized servants in 1851 farm households. (In some 1851 enumeration lists, no distinction is made between farm servant and agricultural labourer.) This occupational change and the decline in the farm labour force are well-documented in the literature on rural Britain (Saville, 1957; Lawton, 1967).

The 1984 farm population can no longer be considered to be as basic a part of the rural sector as it was in the past. Only 14% of the 1981 population of the study area (based on the 10% 1981 "official" sample) were farmers or farm workers. Their representation as part of the total population was low in the larger villages (Farndon 5%; Tilston 7%); the official census, however, did not permit plotting meaningful proportions per parish, because the margin of error was too large in view of the small population of most of the Enumeration Districts. (In most districts the recorded

Figure 6.
Southwestern Cheshire, 1851: Township Rank-Size of Total Agricultural Population



number engaged in farming was between one and three; this figure was sometimes more than half of the labour force.)

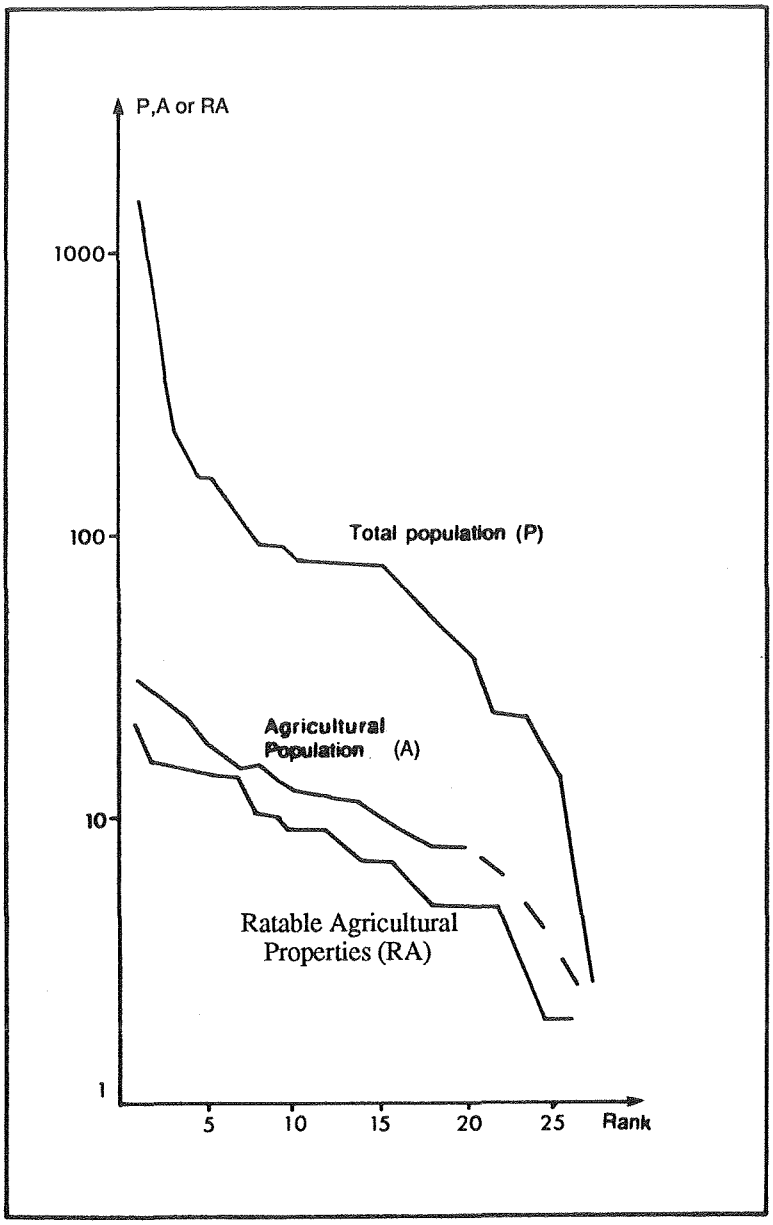
The June returns of the 1982 Census of Agriculture provide a useful alternative to the population census. Care had to be taken, however, when recent records were compared to those of 1851, because, for example, wives or husbands are counted among the labour force in these returns, but were not considered in this regard in 1851 returns unless the woman (a widow) was also head of a household. The role played by sons or daughters in running the farm also presented a problem. Such persons were included in the totals in this analysis only if they were full-time workers. Wives, on the other hand, were excluded because it was assumed that regardless of their status in the household, they took an active part in the farm economy on both dates. Another problem was that of evaluating the various forms of part-time or casual labour. Such labour existed in all farm areas, so they were considered part of the basic farm population in this study, which may have resulted in inflating the size of the 1982 labour force.

The official government policy of confidentiality for the smallest parishes presented an additional problem. Such parishes were combined with one of their larger neighbours in the June 1982 returns, so it was necessary to estimate their data separately (on the basis of map studies and personal acquaintance), assuming an average labour force of three to four persons per farm. The results of this estimation showed the farm-based population to be much more evenly distributed than is the total population. The divergence between the two graphs is more pronounced in the higher ranks (see Figure 7), but was less in 1851, when the strong concentration of farmers in the medium ranks was the major finding (see Figure 6). Clearly, the total farm population was much lower in 1982, as expected, but the general trend of the line remained similar for both dates. Unlike the 1981-82 curve, the mode section of the semi-log line in 1851 closely followed that of the total population.

Ratable Agricultural Properties

A parallel, though not identical, source of information is the rate valuation. The latest data available (1984) was based on a 1974 survey although such data was continually updated. The data distinguishes ratable agricultural property (i.e., farm dwellings and garages) from non-agricultural property because dwellings receive rate discounts. This distinction permits a complete picture of the distribution of farm-based households to be obtained. Unfortunately, it was not possible to verify all the changes that were made to date since 1974. Although it is reasonable to suggest that such updating is incomplete, the original data based on the 1974 survey is pre-

Figure 7.
Southwestern Cheshire—Civil Parish Rank-Size of Total Agricultural Populations and Ratable Properties



sumably of high quality. The 1974 survey data was therefore utilized disregarding the changes (see Figure 7). The clear advantage provided by these records is the full view of the distribution without the restriction of confidentiality.

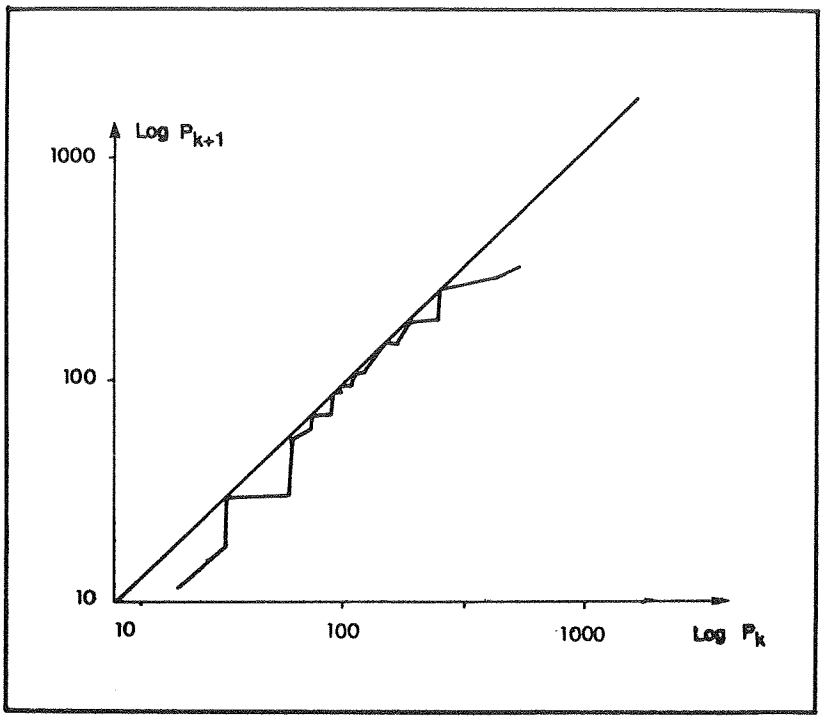
The ranking obtained from this data differs only slightly from that of the Ministry of Agriculture, Fisheries and Food (MAFF) June 1982 returns. The even distribution of ratable agricultural property (21 out of 27 Civil Parishes had between 5 and 16 of such properties) is outstanding, particularly in view of the wide range in the 1981 population size. The ratio of non-agricultural to agricultural properties was, therefore, very high in the larger villages. The ratio was 35.0:1 in the largest, Farndon, and 12.1:1 in the second largest, Tilston, as compared with 0.8:1 in Stretton and 0.6:1 in Overton, two of the smallest units. The mean for the area was 5.4:1. The ratio was generally closely related to population size in the 1982 MAFF data, because the absolute number of farm-based households typically remained constant. This fact is perhaps the clearest expression of the strong relationship found between the rank-size rule and the distribution of farm-based population or property. The flattening of the rank-size curve, i.e., the existence of a mode or monotonic section, can thus be attributed to the impact of the farm-based population.

It has already been demonstrated that changes in the upper part (head) of the southwestern Cheshire rural system were the result of the intrusion of non-rural elements into the largest villages. The role of such elements as providers of services and trade outlets to the surrounding villages decreased between 1851 and 1981 (Grossman, 1985). The steep rise of the upper part of the curve for the recent data (see Figures 8 and 9) cannot be attributed, therefore, to increasing trade or to better regional integration, but is, rather, an expression of the decline of rurality in its traditional, land-bound form. This change has also affected the smaller settlements, to some extent, but it has mainly been responsible for the pronounced polarization that occurred between the (few) growing and the (majority) declining civil parishes, considered by this study as the equivalent of settlement units.

The explanation of the lower part (the tail) of the southwestern Cheshire curve is more complex. This section of the curve reflects single-farm or single-manor townships (Sylvester, 1950, 1969; Chapman, 1953), but also includes settlements that lost population. Such cases are deviations from the general community-oriented parish (or township, before late nineteenth-century reforms took place). The English settlement system is, however, fairly stable, and its "dynamic" parts may be the result of forces operating several centuries ago. Tracing these forces to their inception is particularly difficult because documentation on the topic is scarce.

The Cheshire case demonstrates that the tail can remain stable for a long

Figure 8.
Southwestern Cheshire, 1851: Rate of Change in Settlement Rank-Size System

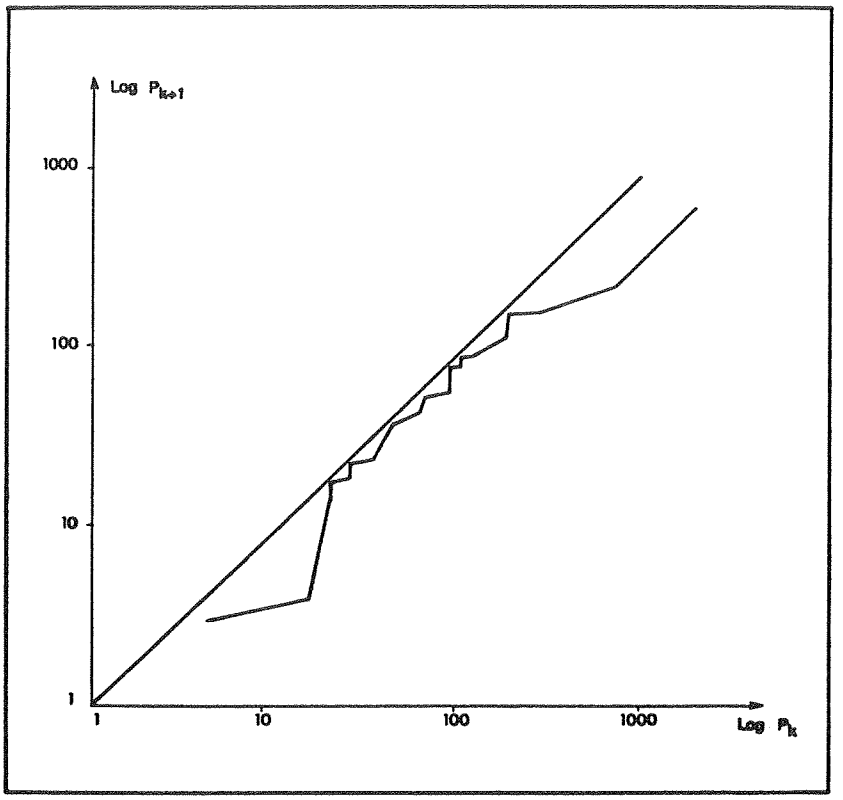


time. The function of the tail as an indicator of change can be better illustrated by focusing on developing areas whose settlement structures are less static. The remainder of this study is centered on Arab settlement systems located in the West Bank and in the Israeli Coastal Plain.

The Role of Resource Variation

Historical processes may be related to resource endowment. The possible impact of the agricultural resources of southwestern Cheshire was deliberately left out of this study, however, because its purpose was to focus on the possible interpretation of the rank-size distribution, by drawing on data that could not be easily obtained through other sources. The relation of such historical processes and resource endowment has been treated pre-

Figure 9.
Southwestern Cheshire, 1981: Rate of Change in Settlement Rank-Size System



viously (Grossman, 1985). It suffices to mention here that most of the Cheshire study area is part of the fairly flat Dee Plain, although its eastern fringe contains some crescent-shaped outliers of the central Cheshire Ridge.

The impact of relief or soil, even if moderate, cannot be totally ignored, but the resource factor can be more properly evaluated by focusing on several larger areas that share cultural unity but differ in resource endowment. The landscape of the study areas of Israel and the adjacent West Bank fill these requirements.

The impact of resources on settlement ranking can take several forms.

Where resources differ, the modal (monotonic) sections of the graphs can be expected to be on different levels, although the general shapes of the rank-size graphs do not necessarily have to be different. The graphs may even have identical forms if territorial, rather than population, size is adjusted to the local resource potential (i.e., if size is large where quality is low).

The quality of the resources, nevertheless, has some impact on population size distribution. Flat and attractive plains have old, well-established rural populations. Central places may be present in greater proportion than in less attractive mountain areas, resulting in a more well-developed *head.*

Where resources are of marginal nature, on the other hand, the instability of settlement can result in pronounced oscillations in the number and size of the settlements. This situation is likely to be associated with a disproportional development of the tail because many marginal settlements are in a dynamic stage of growth or decline. This situation is typical of areas that suffer from a climatic problem, but it is not necessarily associated with rugged areas whose resources can offer stable living conditions. In the latter case, the local standard may only approach a subsistence level, but this environment can be still associated with the most characteristic form of the rural rank-size regularity, because in such a case the underdevelopment of central places may reduce the size of the head while isolation reduces the dynamic processes associated with the tail.

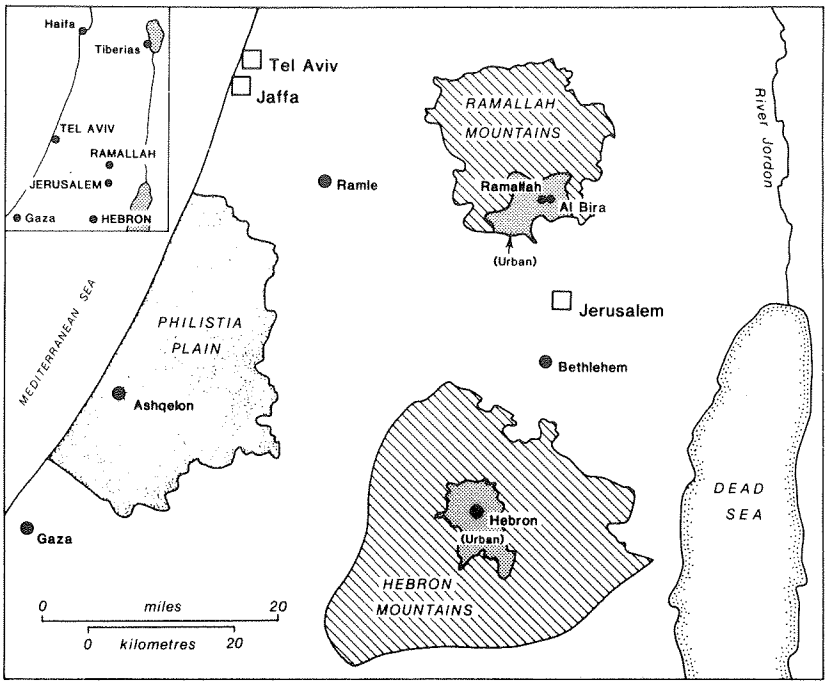
The areas selected for this analysis illustrate the three possible situations just outlined: they include a plain (Philistia), a mountain area (Ramallah), and a climatically marginal, diversified zone (Hebron). The rank-size graphs and the graded (dynamic) transition curves will be presented for each of these three regions. The graphs refer to a number of dates for which data could be obtained.

The range of data available from these records, however, is limited: it was not possible, for example, to isolate the farm-based population. The advantage of the data, however, is that village communities are less ambiguously defined and village units can usually be regarded as "occupational communities" that possess well-defined territories. But this general rule does not apply equally to all areas under study, as will be discussed in the following sections.

The Study Areas in Israel and the West Bank

All of the study areas (see Figure 10) belong to the Arab culture zone, yet each has cultural distinctions. In Philistia (now part of the Israeli southern Coastal Plain) and, to some extent, also in Hebron, Egyptian influence was important, while in Ramallah there was more Christian influence (three

Figure 10.
Study Areas in Palestine



villages have a substantial Christian population). These minor cultural variations should not, however, greatly interfere with the main unifying characteristics of the three zones.

The Arab population data used for the Philistia area refer to the late sixteenth century (1596) and to modern times (1922 and 1945). In the case of Hebron and the Ramallah mountains, it was possible to use more recent (1980) data also. These specific dates were selected because data in a fairly satisfactory form was available (Hütteroth and Abdulfattah, 1977; Palestine, 1923, 1945; Israel, 1980). The first date refers to population records collected for taxation purposes by the Ottoman government (whose rule lasted from 1517 to 1917), while the second date is of British Mandate government census. (This government lasted from 1917 to 1948.) The figures used are from the first complete census taken by the British administration, and it is compared to one of the latest population estimates available for the Mandate period (Palestine, 1945). The comparison of the 1922 and 1945 data measures the changes occurring during this period of

intensive economic development. The Philistia plain was incorporated into Israel after 1948, and its population was totally altered. Because of this development, post-1948 population records cannot be compared with earlier data; but for the Hebron and Ramallah areas, post-Mandate statistics can be utilized and are particularly important for an analysis of Hebron.

The official data refers to village territories rather than to discrete village residential units. In some villages, small detached offshoots (Khirba) existed, but were not separately enumerated. Such settlements were notably rare in the Philistia plain and the Ramallah mountains, but were more numerous in Hebron. A study of aerial photographs taken in December 1944 and January 1945 confirms that the settlements of the Philistia plain and Ramallah were strongly nucleated, with the only deviations a few modern houses established in citrus groves and some ribbon-type development along major roads. These developments reflect in part a non-traditional preference for a lower-density distribution. Except for the detached houses in the groves, there is no reason to believe that the population of the settlement units reported in the various census records do not coincide with that of the village territories in both the Philistia plain and the Ramallah mountains. This reasoning, however, does not apply to the Hebron mountains, where the lack of overlap between the two definitions of residential units must be considered in analyzing the available data.

The 1596 records appear to refer to all the separate residential units, even the smallest ones, as settlements. The taxable category, or mazra'a, an uninhabited, detached taxable field, is equivalent to the khirba and was usually inhabited seasonally. Naturally, some doubt exists as to the completeness of coverage of both territory and population in these records. The study of aerial photographs and several visits to some of the settlement sites deserted after 1596 suggests, however, that the quoted figures conform to the size of the villages. Nevertheless, a strong possibility exists that the actual population was underreported because it was common to try to avoid taxation.

Social organization is an important factor for spatial patterns, especially in land allocation. Traditional land tenure, particularly in the plains, was communal (musha') and included, despite obvious differences, some features of the British open field system (Weulersse, 1946; Sorre, 1952). Land was reapportioned every year or so by the village head. This responsibility was associated with the concentration of authority in the hands of the mukhtar or village head. The system was closely related to Ottoman taxation practices, which involved the use of tax farmers (whose agents were the village heads). In mountain areas it was difficult to apply the musha' system because of the patchy and discontinuous nature of the land (Baer, 1971). The system underwent a number of modifications, particularly in

the nineteenth century (Gerber, 1978; Hütteroth and Abdulfattah, 1977; Cohen, 1973), but these changes did not have an appreciable impact on village forms or patterns by the time of the 1922 census.

The complex causes of the origin and development of the tenurial and taxation systems are of no great concern for this study. It is necessary to note, however, that many large land holdings were created, particularly after the 1858 Ottoman law required the registration of such holdings. This event resulted in an increase of the number of sharecroppers, although sharecropping on various levels had also existed for other reasons (Granovsky, 1949). Because the part of the sharecropper amounted usually to no more than one-sixth to one-third of the goods produced, sharecroppers needed much more land than did freeholders; this situation must have had some impact on the preferred village size, but its extent is hard to evaluate. In addition, the fertile land of Philistia attracted the attention of rich city-based merchants more than did other areas, and, therefore, the problem of sharecropping was more widespread in that location. Various sources also stress the negative impact of corrupt government officials and oppressive taxation (40 to 50% of the farm production of Philistia) on the general welfare of the coastal plain population. According to eighteenth and nineteenth-century sources, this oppression taxation accounted, at least in part, for the underutilization of certain parts of the coastal plain (Volney, 1787; Robinson and Smith, 1841). These comments, however, seem applicable mainly to the margins of Philistia (the Gaza and Ramle areas) that were only sparsely populated.

To the factors already mentioned, the need for protection must be added. This need may partially account for the low population of the Philistia margins. Protection was necessary not only from outsiders (Beduins), but also from raiders from other villages and even from village inhabitants, because internal feuds were common. In the mid-nineteenth century, many regions and villages were divided between rival factions. Frequent eruptions of violence made it necessary to live in well-protected, dense clusters. Adequate protection was needed even in less-exposed mountain areas because attackers were often of local origin (Hoexter, 1973).

This social system began to break down in the late nineteenth century. The 1922 and later rank-size curves, therefore, are not perfect examples of the traditional system, but were affected by the incipient developments of marketing and road improvement. Consequently, a greater concentration of settlements in the higher rank can be expected. The impact of the major towns themselves, however, should not be strong enough to modify or attract urban spillover, because the main, growing towns (Jaffa-Tel Aviv) were located well beyond the study areas.

The Philistia Plain

The Philistia plain is more level than other parts of the study area, and has more uniform resources (between 400 and 500 mm annual rainfall). Because of its geographical position and its level lands, Philistia has provided trade routes and transportation from Jerusalem, Jaffa, and Ramle to Gaza and Egypt throughout the ages. Its population has benefitted from connections with the outside world and the resulting increase in mobility. Despite this trade, however, most of the area's population was mainly engaged in production for local consumption even in the early part of the twentieth century.

The actual proportion of the population engaged in activities other than farming, processing farm products (like oil pressing or milling), provision of farm services, or traditional crafts cannot be accurately stated. Some indication of prevalent economic conditions is obtained by the fact that "shopping" in rural areas was provided mainly by itinerant vendors. Village shops started to appear in the larger and more accessible villages only in the late nineteenth century (Avitsur, 1976). In 1930 it was estimated, however, that the Arab fallah obtained about 12.5% of his income from non-farm employment. This figure was based on a survey of 104 villages located throughout Palestine (Palestine, 1930). During the period of British administration, however, the area experienced accelerated growth. A rail line from Lod (Lydda) to Egypt, Jerusalem, and Tel Aviv as well as major asphalt roads were constructed through the area and near its margins. These developments must have affected settlement size and distribution.

The rank-size graph of the Philistia plain villages shows that they concentrate within a definite size range (see Figure 11). This result stands out most clearly in the 1922 records, where 25 of 45 settlements had between 300 and 800 people. The number of settlements with fewer than 300 people was only 5. There were, however, as many as 14 settlements whose population numbered more than 800 (of which 4 had over 2,000 residents). This situation resulted in a clear separation between the villages within the modal range and those above it (i.e., the head). The difference between the monotonic section and the two ends is clear (see Figure 12); it is evident that the middle sector is dominant.

The 1596 findings are more difficult to interpret. The curve's basic outline conforms to the expected rural patterns, but the number of small settlements is high (see Figures 11 and 13). There is also an unexpectedly large number of bigger villages (population of 400 and above). The number of settlements in the modal range is thus small and deviations from the norm are greater when compared to 1922 data.

It is possible to interpret this result as an indication of intra-regional

Figure 11.
Philistia Plain—Rank-Size of Village Population

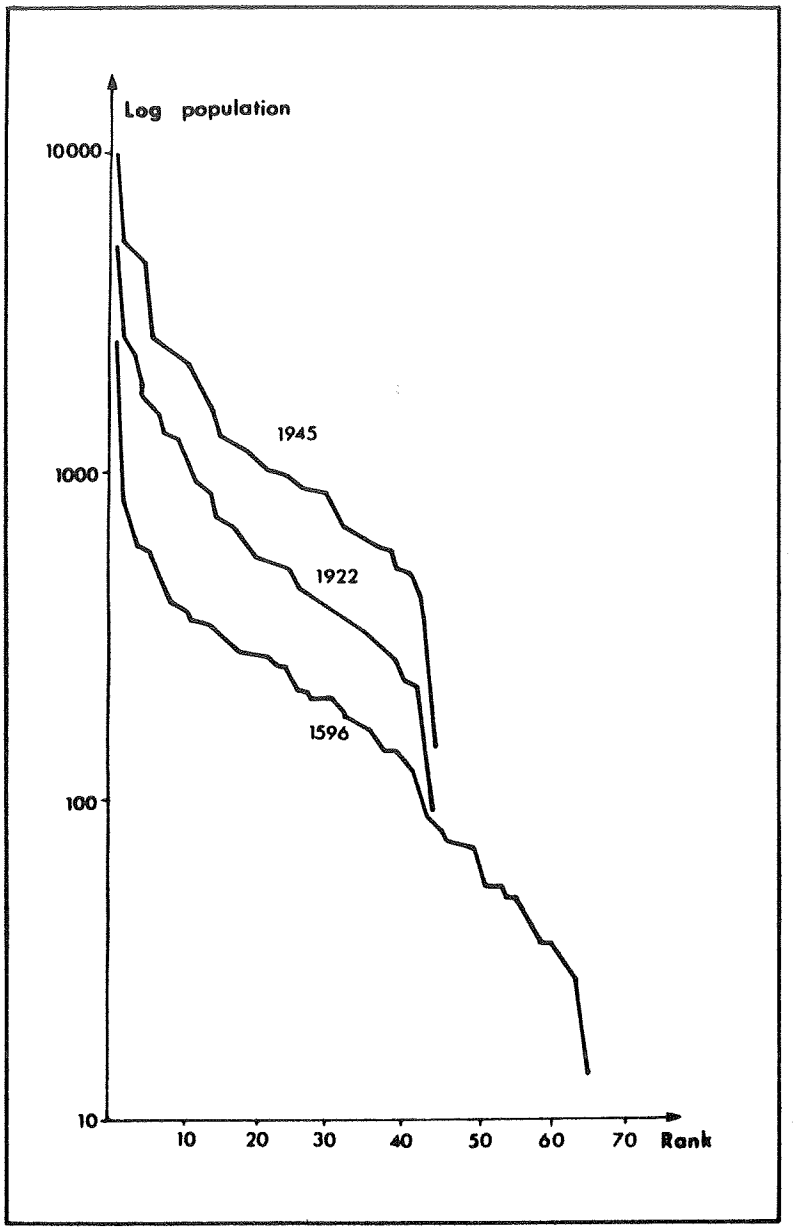
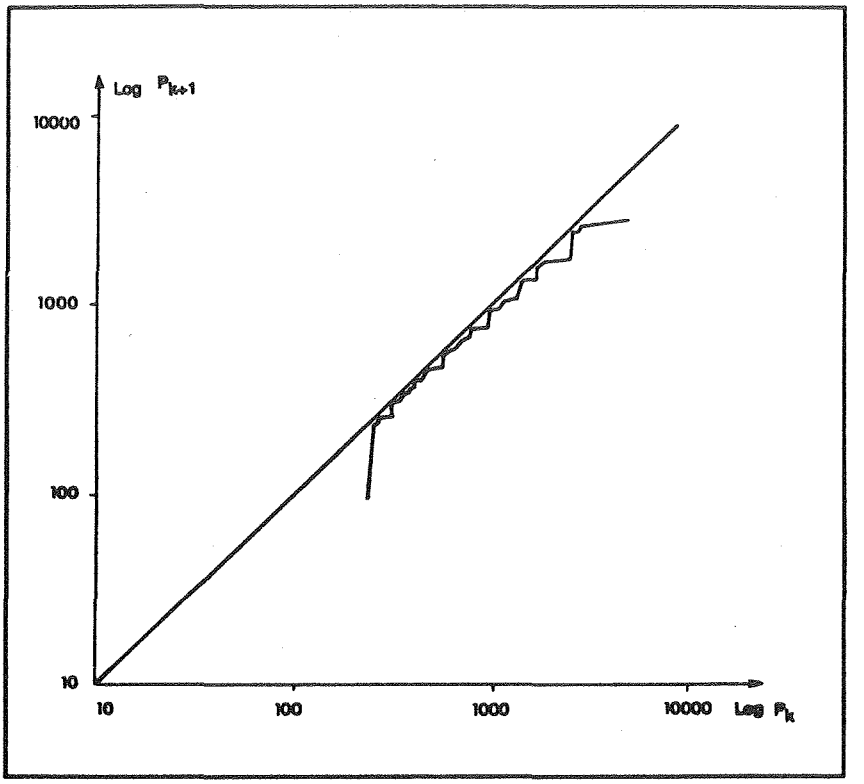
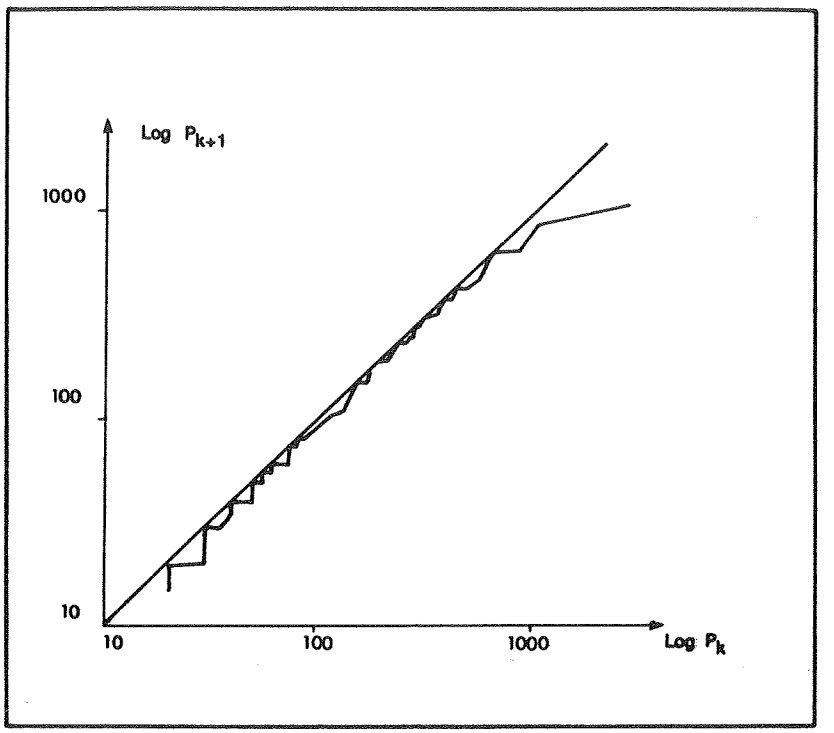


Figure 12.
Philistia Plain—Rate of Change in Settlement Rank-Size System (1922)



imbalance. Although the reasons for such an imbalance are not fully known, a partial explanation can be sought in the dominant economic position of Gaza in the sixteenth century. At that time, Gaza was the most important market in the country, with a great variety of commercial activities (Hütteroth and Abdulfattah, 1977; Cohen and Lewis, 1978). The neighbouring town of Majdal, located in a more humid part of Philistia, benefited from Gaza's prosperity. Majdal had a population of almost 3,000 (a sizeable settlement by standards of time), and was surrounded by many villages that were deserted in later years. The attractiveness of the larger villages and towns could have distorted the settlement patterns by increasing the ranks of the upper as well as the lower limbs as smaller settlements were formed near major markets.

Figure 13.
Philistia Plain—Rate of Change in Settlement Rank-Size System (1596)



This pattern may also be the result of processes of change that included desertion of villages resulting either from violence or economic deterioration. The two sets of forces are not mutually exclusive, and it is likely that they had a common cause. The exact nature of such processes is not known.

The settlement pattern in the sixteenth century was clearly less regular than it was in the nineteenth and twentieth centuries (Grossman, 1983). Deviations from the expected graph observed by these authors fit well with the findings of the pattern analysis, but a full explanation must wait until more complete and accurate historical information is available.

The high stability of the more recent patterns (1922 to 1945) is also reflected in nineteenth-century data. The Guérin estimates for 1863 are the

most compatible with twentieth-century records (Guérin, 1969). This author listed five villages with a population of less than two hundred. His records however, are incomplete, and the estimates far from adequate. A close study of nineteenth-century data, paticularly since 1838, when Robinson and Smith listed all the villages in the area (1841), indicates a high degree of stability. A comparison with 1922 census data suggests that only three villages were added between 1838 and 1922.

The Ramallah Area

The Ramallah area is more humid than Philistia (500 to 600 mm rain per annum). This area is composed of steep, irregular hills and mountains that are separated by narrow, winding valleys. The mountaintops and hilltops have some arable land, although the soil there is shallow, and the farmland is found mainly in deeper soils of the surrounding valleys. Because of the horizontal bedding of alternating layers of hard limestone and soft marl, the slopes can be easily terraced and are largely cultivated for olives. Other fruit trees, mainly almonds, are also found. The tendency in recent years has been to shift from grain to olive cultivation, particularly on the terraced slopes.

Available records, particularly those from the nineteenth century (Finn, 1878; Hoexter, 1973) suggest that internal violence was also widespread in this area. Data from earlier periods is scarce because the mountain area was less accessible to travellers and did not contain any religious shrines or other attractive destinations. Despite the violence and its ruggedness, the area resembles Philistia in the stability of its settlements and in the general absence of reserves of open, under-used agricultural land. Ramallah is less productive, however, and does not have adequate access to urban centres.

The settlements of the Ramallah mountains were clearly smaller than those of Philistia. In the modal (monotonic) section, the range in 1596 was between 40 and 400, but the tail was well-developed. It is unlikely that this result was caused by differing official definitions of the units of settlement, because as in Philistia there were few isolated offshoots in the village territories. It is probable that the sixteenth-century population was more dispersed than it has been in the present century because farming was less intensive and herding more widespread in the earlier period.

The territorially-based definition that prevailed during British administration (1917-1948) does not apply to the 1980 data, where individual settlements were identified as geographically separate built-up areas. This definition accounts for a minor extension of the tail, but significantly the smallest settlements still had close to 100 people. The tail appeared to be relatively insignificant. The head, on the other hand, was clearly impor-

tant. In 1596 there was little head, but for the other two dates studied, the head had become progressively distinct. This phenomena is most probably due to the growth of the non-rural sector in the area as a result of non-farm employment.

Probably most important is the general uniformity of the monotonic (modal) part (see Figures 14, 15, and 16). In 1596, the modal range was 40-400; in 1922 it rose to 100-600, and in 1980 to 600-1600; in the most recent case, however, it was clearly reduced to include about 60% of all settlements. The general trend of the line has not changed. The most recent (1980) line (see Figures 14 and 16) clearly represents a residual condition. The agricultural component responsible for the modal part is low. No statistics are available to measure the exact level of agricultural employment on a village-by-village basis, but the Ramallah subdistrict has one of the lowest levels of such employment in the West Bank. This is related to its relatively low carrying capacity (Grossman, 1981).

The lack of a well-defined head and tail (see Figures 14 through 16) is clearly evident. The reason for this can be found partly in the area's low attractiveness, resulting from its rugged terrain and consequent low accessibility. Trade connections, therefore, were far less developed than in Philistia. This situation conforms to Paynter's thesis (1982). These same conditions, however, are responsible for saving Ramallah from adverse exploitation by absentee landlords, which could have compensated to some extent for the adverse impact of the rugged terrain on settlement size. Ruggedness, however, still accounts for the less monotonic mode compared with that of Philistia.

The tail is not always of the marginal significance it had in Ramallah. The fluid nature of often untraceable or loosely-defined small hamlets and homesteads presents a problem of definition if the official records ignore these hamlets or include them in larger territorial units. This possibility has been of little concern earlier in this study because practically all settlements were officially recognized and had well-defined territories. The problem cannot be ignored, however, in the Hebron mountains and their marginal areas, which unlike the Ramallah mountains or the Philistia plain, have a majority of loosely-defined settlements and less well-defined territories.

Administrative confusion and instability is often, however, related to the actual instability of the settlement system itself. A small mazra'a or khirba whose origin can be found in a seasonal settlement is correctly regarded as unqualified for the term settlement even if it is based on its own land unit. It is not, in other words, a real "occupational community." The next section of this article illustrates the relationship between this phenomenon and the rural rank-size rule.

Figure 14.
Ramallah Mountains—Rank-Size of Village Population

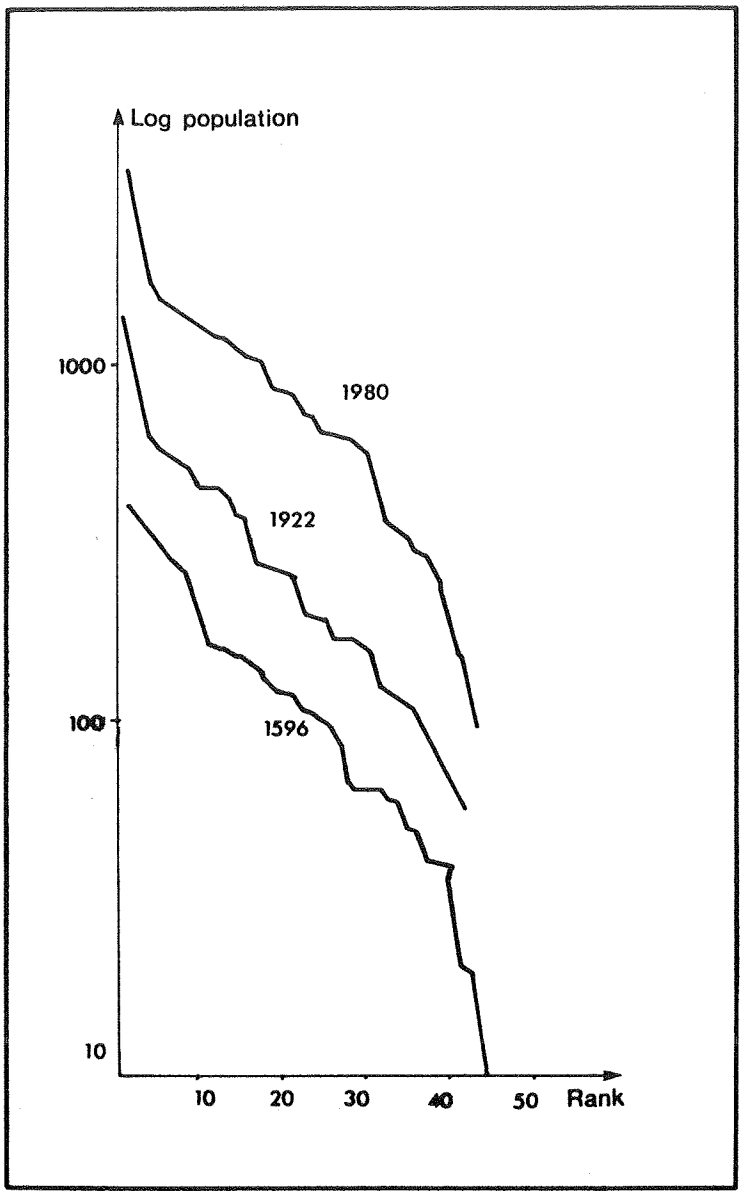
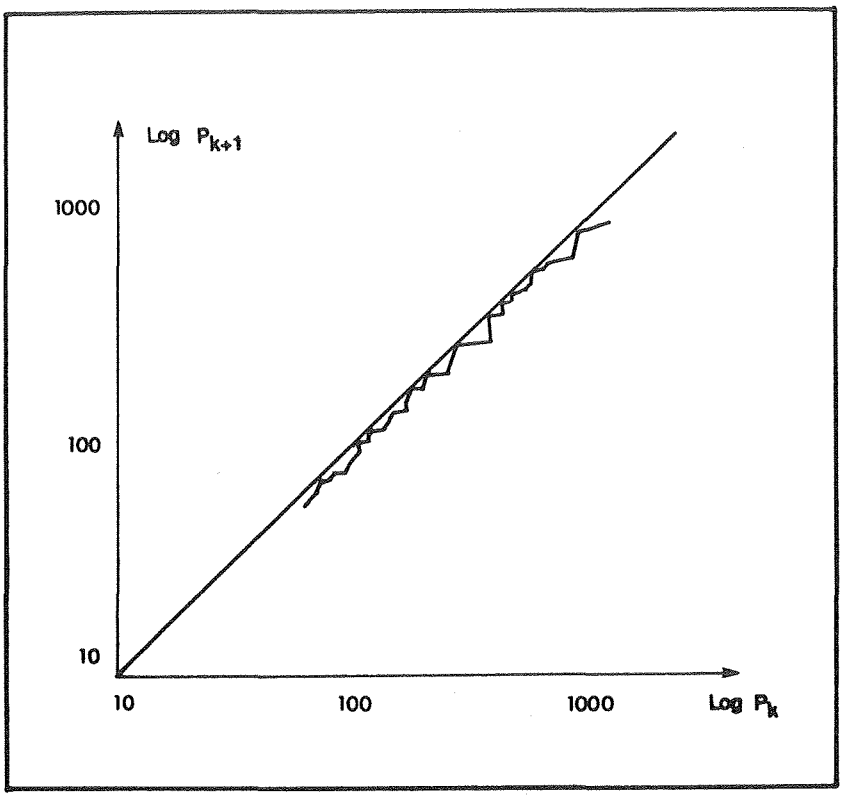


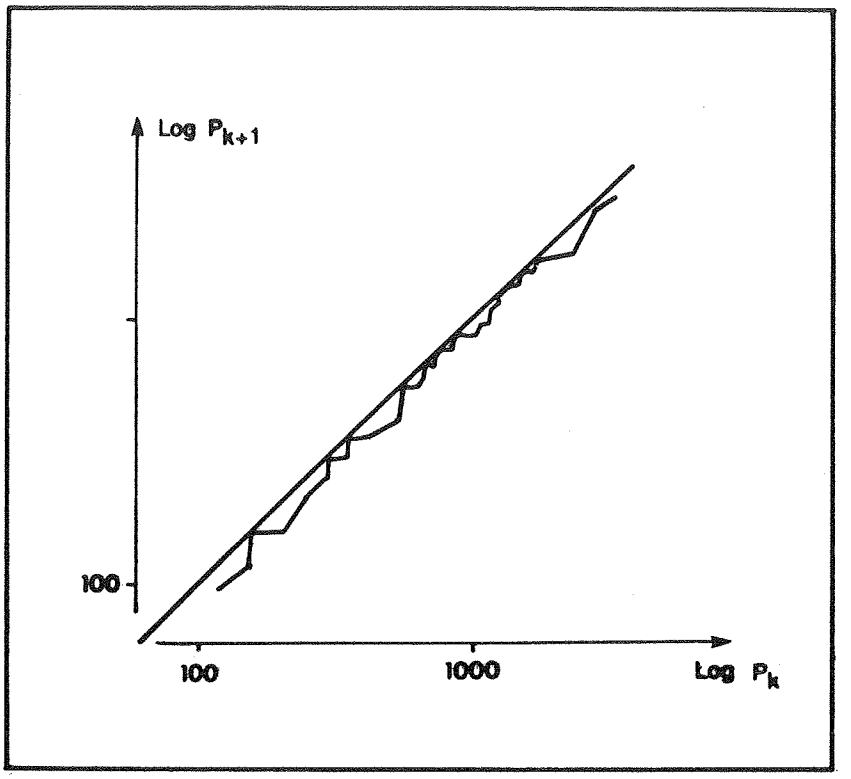
Figure 15.
Ramallah Mountains—Rate of Change in Settlement Rank-Size System (1922)



The Hebron Area

Unlike the Ramallah mountains, the Hebron area has a varied climate. Its farm resources have a distinctly linear pattern upon which settlements are superimposed. This environmental pattern results from the double anticlinal structure that is particularly pronounced topographically on the western side of the mountains. The steeply dipping, hard limestone beds produce a rocky, uninhabited surface. This belt (2-5 km wide) separates the western valleys from the mountaintop zone where most of the older villages are located. The eastern slopes, which contain a series of steep cliffs,

Figure 16.
Ramallah Mountains—Rate of Change in Settlement Rank-Size System (1980)



descend to the Dead Sea. The eastern slopes are not included in this discussion because they contain no permanent settlements.

The Hebron area topography is associated with a unique climate. The mountaintop zone has 450 to 600 mm of annual rainfall, but this rainfall is restricted to a narrow belt. To the east, the Judean Desert (50-200 mm of rain per annum) begins within a distance of 3 to 5 km from the head of the slopes, while in the south there is a gradual decline of precipitation from about 400 to 200 mm per annum over a distance of some 10-15 km. In the west, the decline (from 500 to about 250 mm per annum) is experienced within a narrow distance (about 5 km) as the steep, rocky escarpment is descended. Such variety in physical conditions is reflected in land use

patterns and in the nature of the settlements in each of the Hebron landscape units (Grossman, 1984).

Because farming was handicapped by low and uncertain precipitation on the periphery of the mountains, settlements there acquired the characteristics of unstable frontier villages or hamlets. Many of them were only seasonally or temporarily inhabited during the majority of Ottoman rule. These settlements became fixed only when population pressures increased and when moderization made it possible to better cope with the hazards of drought. This settlement process can be traced back to the nineteenth century and before (Grossman, 1981, 1982).

How then is this complexity reflected in the rank-size distribution? Because of the nature of the available data, only a partial answer can be obtained. In the sixteenth century (1596), most villages (as defined in official tax records) contained less than 100 persons (Hebron town is not included), although their sizes varied substantially. The 1596 data more closely resembles the expected graph than does most of the twentieth-century data, but the number of unrecorded settlements, either temporary or fixed, cannot be estimated (see Figure 17).

The period of British rule, exemplified here by the Village Statistics of 1945 (Palestine, 1945) is the most problematic time. Only nineteen villages were officially registered but this only happened because of the way a village was defined. Many small settlements, most of them temporary or fixed offshoots established in the surrounding marginal areas, were counted in 1931 as part of their larger "mother" settlements (Palestine, 1932). Thus, Dura had 70 khirba settlements under its name. A large part of its 1931 population (7,255) was obviously dispersed in these offshoots. Eight other villages also had between two and eight registered offshoots. It is therefore clear that the 19 officially-recognized villages made up only a small fraction of the real number of inhabited places. Aerial photographs taken at this time reveal that most of the offshoots were fixed settlements by the 1940s, depending on their mother settlements only for some summer grazing.

The very fact that the British administration opted to ignore the existence of many hamlets and villages is a reflection of the difficulties the officials had in the dispersed area of Hebron. The population of the outlying villages was registered for the first time in the 1961 Jordanian Census, but the definition of a settlement was restricted to places with a population of at least 100 (Jordan, 1964). The 1980 patterns presented here (see Figures 17 and 18) are based on estimates made by the Israeli Military government; these estimates are more accurate than are numbers from the official 1967 Israel Census (Israel Defense Forces, 1968; Israel, 1980). The military government's records contain a settlement with as few as four persons, but the

Figure 17.
Hebron Zone—Rank-Size of Village Population

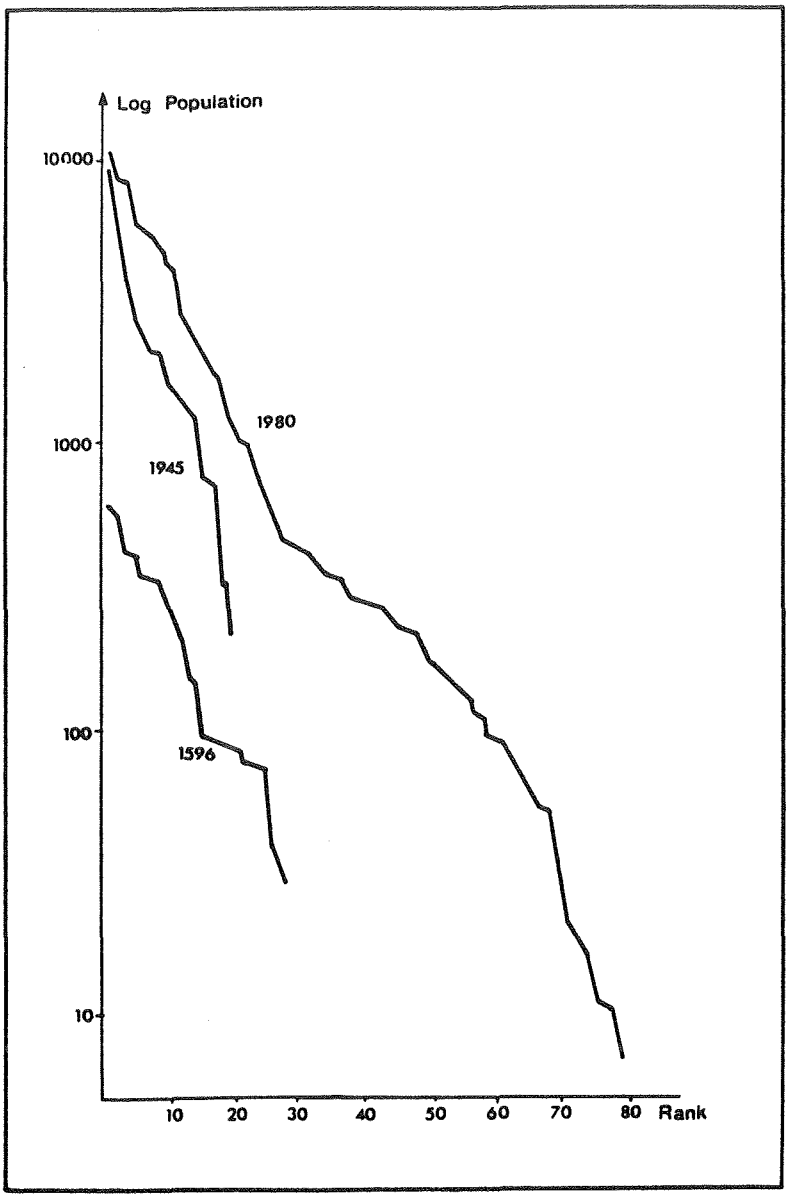
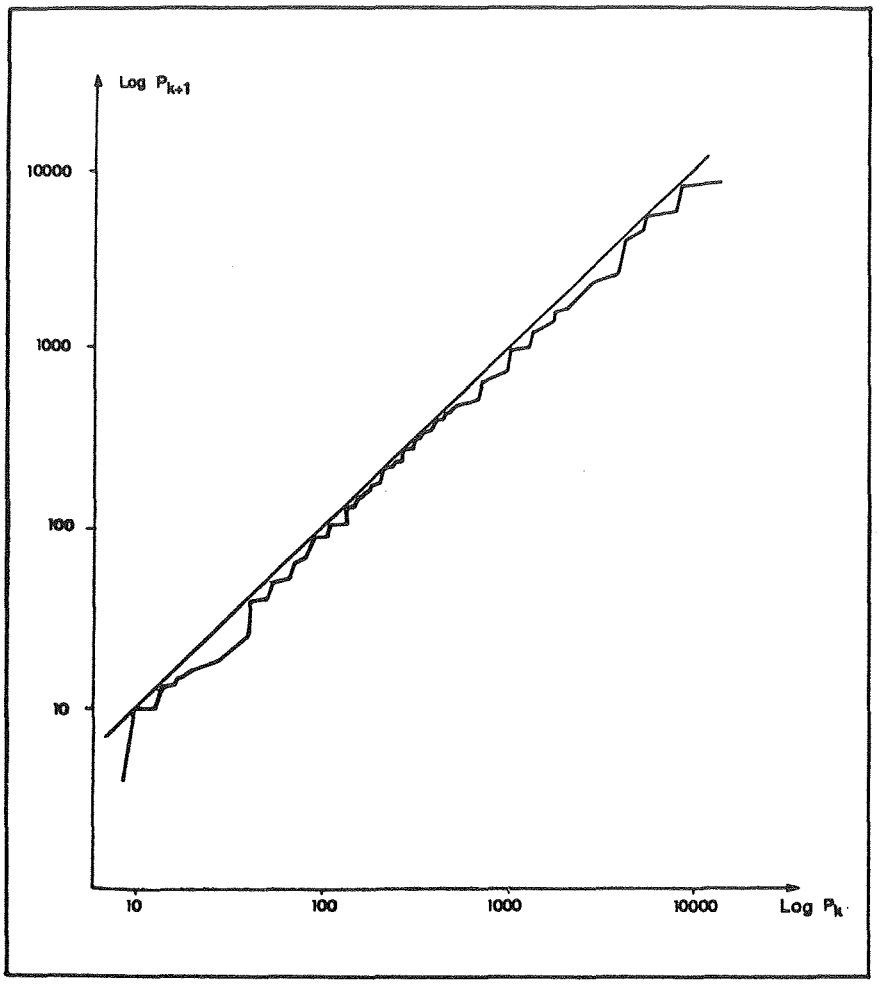


Figure 18.
Hebron Zone—Rate of Change in Settlement Rank-Size System (1980)



problem of definition remains because the criteria used to decide which contiguously-settled units should be considered real "independent" settlements is unclear.

The rank-size distribution obtained from these 1980 Hebron data is clearly different from those of the areas previously discussed. (On the double-logarithmic paper, the tail composed of the smallest ranks tends to be

much more pronounced than the mode.) The range was found to be extreme—from 4 persons to more than 13,000.

The most monotonic section of this long graph (in the range of 130 to 500—see Figure 18) consists mostly of the offshoot settlements that were not recognized as independent communities before 1948. The largest of them now includes over 2,000 people and is already in the head part of the graph. The lower section (the tail) does not have clearly-defined limits, athough its lowest part (4 to 40) consists of newly-created clusters that are often no more than neighbourhoods built in relatively isolated locations in the rugged escarpment zone.

The "normal," well-established villages are still dispersed along the graph, but most of them occupy the head section. Although some of them, particularly those that occupy roadside locations, have developed central place functions (e.g., the towns of Halhul and Dura), others have retained a rural character. It is not really possible to correlate any part of the graph with core-periphery relationships; the explanation for such relationships lies in the uniqueness of their dynamic evolution, i.e., in the process of fixation of their caves or ruin-shelters, and in the ability to expand as a result of off-farm employment (particularly after 1967). It is, indeed, unfortunate that the evolution of this system cannot be accurately traced.

The fixation process that began during the late nineteenth century has obviously reached a certain level of maturity, but when the graphs of Hebron (see Figures 17 and 18) are compared with those of other areas, the differences between them are obvious. These differences are the result of the highly dynamic situation that tends to obliterate the shape of the rural rank-size system.

Conclusion

The authors' presentation of the rank-size rule helps discriminate between the various elements of rural space. This presentation brings out the polarization process that occurred in Cheshire by illustrating the unusual growth of the upper, nonmonotonic part of the curve. The fact that none of the Arab regions is asssociated with a similar process is made clear by all the graphs whose nonmonotonic head is only slightly developed.

The polarization process should not be confused with central place formation. The equation of any part of the graph with such formation or with any other specific process or dynamic development is, indeed, an impossibility. This inability also applies to the lower part, the tail. The Hebron case is an illustration of an oversized tail and oversized head. A fairly well-developed tail also appears in the case of Philistia in 1596, but it is impossible to interpret this situation because sufficient information is not available

to explain the processes operating during the period. This situation suggests that while rank-size regularities can be used to identify deviations, these graphs are not useful in determining their causes.

No absolute proof was found that would show that the monotonic section in the modal part of the graph can be explained by territorial or land orientation. It is impossible to isolate a strong dependence on land from low off-farm opportunities, low development of outward trade, poor communications, and a host of other elements that characterize rural occupational communities. The authors believe, however, that this study provides some evidence to support the thesis that the modal (monotonic) section is not merely a phenomenon of peripherality, but is also the result of agrarian considerations that are manifest in the territorial orientation of settlement systems.

The modal section is well-developed in Philistia and Ramallah, particularly for the early years of the present century (1922), when economic development was initiated. The Ramallah region comforms better to the model of rurality, if it is explained by poor development and low level of communications, but Philistia's modal section is somewhat more compact. This phenomenon reveals that even where outside ties are relatively well-developed, the mode remains unaffected if the basic internal elements of rurality (i.e., a community organized to manage the agricultural economy) are present.

The greater deviations from the mode present in Ramallah may be the result of variations in relief, but the pattern is clearly rural despite such variations. This study helps illustrate the existence of a difference between areas of varying topography. Plains appear to have more uniformly monotonic modes than do mountains, but this theory obviously requires further testing.

The greatly expanded unique rank-size system of the Hebron mountain zone is related to its colonization process. This system is associated with the marginality and the variety of resource base in this area. The uniqueness of this rank-size system illustrates the conditions likely to evolve when a marked deviation from the rule occurs, i.e., when the territorial basis is not the major factor in determining settlement distribution. When this spatial element (territoriality) is missing or lessens, the rank-size rule is drastically altered.

No attempt has been made in this article to suggest the applicability of the rank-size rule to community planning. The rural conditions represented by the rule are not necessarily associated with desirable development; rurality has often been a state of stagnation and low technology. It is to be expected, therefore, that modern rural communities will prefer settlement patterns that are quite different from more traditional ones.

References

Allen, G. R. 1954. The 'Courbe des Populations': A Further Analysis. *Bulletin of the Oxford University Institute of Statistics* 16, pp. 179-89.

Auerbach, F. 1913. Das Gesetz der Bevölkerungskonzentration. *Petermanns Geographische Mitteilungen* 59, pp. 74-76.

Avitsur, S. 1976. *Daily Life in the Land of Israel in the Nineteenth Century.* Jerusalem: Rubenstein (Hebrew).

Baer, G. 1971-3. *Introduction to the History of Agrarian Relations in the Middle East, 1800-1970.* Tel Aviv: Hakibbutz Hameuchad (Hebrew).

Baker, A. R. H. 1969. Reversal of the Rank-Size Rule: Some Nineteenth Century Rural Settlement Sizes in France. *The Professional Geographer* 21, pp. 386-92.

Boserup, E. 1965. *The Conditions of Agricultural Growth.* Chicago: Aldine.

Boserup, E. 1981. *Population and Technological Change.* Chicago: Univ. of Chicago Press.

Bunce, M. 1982. *Rural Settlement in an Urban World.* London: Croom Helm.

Burtchett, C. A. 1969. The Size Continuum of Small Settlements in the Central Loire Valley, 1846-1946. *Geographic Articles* 12, pp. 15-22.

Chapman, V. 1953. Open Fields in West Cheshire. *Transactions of the Historic Society of Lancashire and Cheshire for the Year 1952* 104, pp. 35-59.

Christaller, W. 1966. *Central Places in Southern Germany.* Trans. by C. W. Baskin. Englewood Cliffs, N.J.: Prentice Hall.

Cohen, A. 1973. *Palestine in the Eighteenth Century.* Jerusalem: Magnes Press.

Cohen, A. and B. Lewis. 1978. *Population and Revenue in the Towns of Palestine in the Sixteenth Century.* Princeton: Princeton Univ. Press.

Cowie, W. J. 1983. Towards a Normative Concept of Settlements: The Development Process and Theoretical and Conceptual Problems in the Lower Limb. *Geoforum* 14, pp. 55-73.

Demangeon, A. 1927. La Géographie de l'Habitat Rural. *Annales de Géographie* 36, pp. 13-17.

Demangeon, A. 1947. *Problèmes de Géographie Humaine.* 3rd ed. Paris: Colin.

Dodgshon, R. A. 1980. *The Origin of British Field Systems: An Interpretation.* London: Academic Press.

Enyedi, G. 1975. *Research Problems in Rural Geography, Discussion of a Questionnaire.* Budapest: IGU Working Group for Rural Planning and Development.

Finn, J. 1878. *Stirring Times.* London: Kegan Paul.

Gerber, H. 1978. The Ottoman Administration of the Jerusalem *Sanjak* 1890-1908. *Asian and African Studies* 12, pp. 33-76.

Gleave, M. B. 1962. Dispersed and Nucleated Settlement in the Yorkshire Wolds 1770-1850; *Transactions of the Institute of British Geographers* 30. *English Rural Communities*; edited by D. R. Mills. London: Macmillan, pp. 98-155, 1973.

Granovsky (Granott), A. 1949. *The Land System in Palestine.* Tel Aviv: Dvir (Hebrew).

Grossman, D. 1981. Population Growth in Reference to Land Quality: The Case of Samaria 1922-1975. *Geographical Journal* 147, pp. 188-200.

Grossman, D. 1982. The Expansion of the Settlement Frontier on Hebron's Western and Southern Fringes. *Geographical Research Forum* 5, 57-73.

Grossman, D. 1983. The Southern Coastal Plain of Israel—Patterns of Settlement.

Paper delivered at the annual meeting of the Association of American Geographers, Denver, Colorado.

Grossman, D. 1984. Land Use Modifications and Population Growth in the Southern Hebron Mountains. In *Rural Life and the Exploitations of Natural Resources in Highlands and High-Latitude Zones*, edited by R. Majoral and F. Lopez. Barcelona: Department of Geography, Univ. of Barcelona, pp. 153-62.

Grossman, D. 1985. Rural Polarization—Population, Occupational Structure, Service Provision, and Settlement Characteristics. Paper delivered at the conference on Management of Rural Resources: Problems and Policies, Guelph, Canada, July 14-20, 1985.

Guérin, V. 1969. *Description Geographique, Historique et Archéologique de la Palestine*, Part 1: *Judée*. 3 vols.; reprint of Paris 1869 ed. Amsterdam: Oriental Press.

Gunawardena, K. A. 1964. Service Centres in Southern Ceylon, Ph.D. diss., Univ. of Cambridge.

Haggett, P. 1965. *Locational Analysis in Human Geography*. London: Arnold.

Hart, J. F. 1984. Population Change in the Upper Lake States. *Annals of the Association of American Geographers* 74, pp. 221-43.

Hoexter, M. 1973. The Role of Qays and Yaman Faction in Local Political Divisions. *Asian and African Studies* 9, pp. 249-312.

Hütteroth, W. D. and K. Abdulfattah. 1977. *Historical Geography of Palestine, Transjordan and Southern Syria in the Late Sixteenth Century*. Erlangen: Palm and Enke.

Israel. 1980. Population Estimates. Mimeo.

Israel Defense Forces. 1968. *Population Census 1967*. Jerusalem: Central Bureau of Statistics.

Johnson, E. A. J. 1970. *The Organization of Space in Developing Countries*. Cambridge, Mass.: Harvard Univ. Press.

Johnson, G. A. 1977. Aspects of Regional Analysis in Archaeology. *Annual Review of Anthropology* 6, pp. 479-508.

Johnson, G. A. 1980. Rank-Size Convexity and System Integration: A View from Archaeology. *Economic Geography* 56, pp. 234-47.

Jones, G. I. 1949. Ibo Land Tenure. *Africa* 19, pp. 309-23.

Jordan, Hashemite Kingdom, Department of Statistics. 1964. *First Census of Population and Housing, November 18, 1961*. Amman.

Kelly's Directory of Cheshire, 1939. London: Kelly's Directories Ltd.

Lawton, R. 1967. Rural Depopulation in Nineteenth Century England. In *Liverpool Essays in Geography: A Jubilee Collection*, edited by B. W. Steel and R. Lawton; reprinted in 1973. *English Rural Communities: The Impact of a Specialised Economy*, edited by D. R. Mills. London: Macmillan, pp. 195-219.

Lefebvre, T. 1934. L'habitat Rural dans ses Rapports avec le Milieu Physique et Humain. *Comptes Rendus du Congres International de Geographie Paris, 1931* Tome 3. Paris: Colin, pp. 269-72.

Meitzen, A. 1895. *Siedlung und Agrarwesen der Westgermanen und Ostgermanen der Kelten, der Raemer, der Finnen und der Slaven*. Berlin.

Mills, D. R. 1959. The Development of Rural Settlement Around Lincoln," *East Midland Geographer*. 11, 1973. *English Rural Communities: The Impact of a Specialised Economy*, edited by D. R. Mills. London: Macmillan, pp. 83-97.

Newby, H. 1977. *The Deferential Worker, A Study of Farm Workers in East Anglia*. London: Allen Lane.

Newby, H. 1979. *Green and Pleasant Land?* London: Hutchinson.
Orwin C. S. and C. S. Orwin. 1967. *The Open Fields.* 3rd ed.; Oxford: Clarendon Press.
Pacione, M. 1984. *Rural Geography.* New York: Harper Row.
Pahl, R. E. 1966. The Rural-Urban Continuum. *Sociologia Ruralis* 6, pp. 299-329.
Pahl, R. E. 1970. *Patterns of Urban Life.* London: Longmans Green.
Palestine. 1923. *Report and General Abstracts of the Census of 1922,* October 23, 1922. Jerusalem.
Palestine. 1930. *Report of a Committee on the Economic Conditions of Agriculture in Palestine and the Fiscal Measures of Government in Relation Thereto.* Jerusalem: Greek Convent Press.
Palestine. 1932. *Census of Population of Palestine 1931.* Jerusalem.
Palestine. 1945. *Village Statistics.* Jerusalem.
Paynter, R. 1982. *Models of Spatial Inequality, Settlement Patterns in Historical Archeology.* New York: Academic Press.
Philips, D. and A. Williams. 1984. *Rural Britain: A Social Geography.* Oxford: Basil Blackwell.
Roberts, B. K. 1977. *Rural Settlement in Britain.* Folkestone, Kent: Archon Books.
Roberts, B. K. 1982. *Villiage Plans.* Aylesbury: Shire Publications.
Roberts, B. K. 1983. Of Landscapes and Words. In *Villages, Fields and Frontiers,* edited by B. K. Roberts and R. E. Glassock. London: B.A.R. International Series 185, pp. 21-42.
Robinson, E. and E. Smith. 1841. *Biblical Researchers in Palestine Mount Sinai and Arabia Petraea: A Journal of Travels in the Year 1938.* Boston: Crocker and Brewster.
Saville, J. 1957. *Rural Depopulation in England and Wales, 1851-1951.* London: Routledge and Kegan Paul.
Skinner, G. W. 1977. Regional Urbanization in Nineteenth Century China. *The City in Late Imperial China,* edited by G. W. Skinner. Stanford: Stanford Univ. Press, pp. 211-49.
Sonis, M. and D. Grossman. 1984. Rank-Size Rule for Rural Settlements. *Socio-Economic Planning Sciences* 18, pp. 373-80.
Sorre, M. 1952. *Les Fondements de la Géographie Humaine.* Tome III: *L'Habitat, Conclusion Générale.* Paris: Colin.
Sylvester, D. 1950. Rural Settlement in Cheshire—Some Problems of Origin and Classification. *Transactions of the Historic Society of Lancashire and Cheshire for the Year 1949* 101, pp. 1-37.
Sylvester, D. 1957. The Open Fields of Cheshire. *Transactions of the Historic Society of Lancashire and Cheshire* 108, pp. 1-33.
Sylvester, D. 1960. The Manor and the Cheshire Landscape. *Transactions of the Lancashire and Cheshire Antiquarian Society* 70, pp. 1-15.
Sylvester, D. 1967. Parish and Township in Cheshire and Northeast Wales. *Journal of Chester Archaeological Society* 54, pp. 23-35.
Sylvester, D. 1969. *The Rural Landscape of the Welsh Borderland: A Study in Historical Geography.* London: Macmillan.
Tate, W. E. 1969. *The Parish Chest, A Study of the Records of Parochial Administration in England.* 3rd ed. Cambridge: Cambridge Univ. Press.
Taylor, C. 1970. *Dorset.* London: Hodder and Stoughton.
Taylor, C. 1983. *Village and Farmstead.* London: George Philip.
Uhlig, H. 1961. Old Hamlets with Infield and Outfield Systems in Western and Central Europe. *Geografiska Annaler* B43, pp. 285-312.

Unwin, P. T. H. 1981. The Rank-Size Distribution of Medieval English Taxation Hierarchies with Particular Reference to Nottinghamshire. *Professional Geographer* 33, pp. 350-60.

Veulersse, J. 1946. *Paysans de Syrie et du Proche-Orient.* 3rd ed. Paris: Gallimard.

Volney, M. C-F. 1787. *Travels through Syria and Egypt in the Years 1783, 1784 and 1785.* Republished 1972. London: Robinson.

Webb, S. and B. Webb. 1906. *English Local Government from the Revolution to the Municipal Corporations Act: The Parish and the County.* London: Longmans Green.

Zipf, K. G. 1949. *Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology.* Cambridge, Mass.: Addison Wesley.