Field Studies 5 (1980), 259-288

CENTRAL PLACE PROVISION IN THEORY AND PRACTICE: AN EVALUATION IN SHROPSHIRE

By DAVID JOB
Preston Montford Field Centre, Shrewsbury SY4 1DX

and

MAGGIE JARMAN
Clifton High School for Girls, Bristol

ABSTRACT

Couched purely in economic terms, Christaller's "Central Place Theory" attempts to explain the sizes, numbers, functions and locations of settlements. As with any model, the complexity of the real world is simplified by the exclusion of variables thought to be of minor importance whilst focusing attention on those of greatest significance. This paper examines the results obtained when the theory is applied to the Shropshire landscape and concludes that the model provides a useful framework for the generation of hypotheses, the organisation of fieldwork and the analysis of data. The results, however, need to be assessed carefully in the light of the extent to which the assumptions inherent in the model have been fulfilled.

INTRODUCTION

THE PATTERN of settlements in the landscape provides a rich and challenging field of study for the geographer. The distribution of settlements in rural areas often shows a high degree of order and structure. A glance at a map may reveal some regularity in the spacing of the main market towns, often with smaller towns occupying gaps inbetween. The popular use of such terms as "hamlet", "village", "market town", "county town" or "city" implies that settlements can be classified according to their population size and spatial extent. Furthermore such terms often have certain connotations relating settlement size to function; the number and types of shop they contain, their commercial and public services, and their administrative status. Casual observation in any rural settlement will demonstrate that the place, whatever its size, does not exist or function in isolation from its surroundings, but is intimately linked with a surrounding territory (hinterland) and the other settlements therein. Some of the shoppers in the main street may well have travelled in from nearby villages and farms. They may not manage to satisfy all their requirements there and will occasionally travel farther to a larger place for the more specialised goods and services. Settlements of all sizes thus form parts of a system whose components are functionally linked by the flow and movement of people, traffic, goods, money, and information.

Having recognised apparent order and structure in settlement systems, is it possible to construct generally-applicable hypotheses to account for these characteristics? Geographers are coming to realise that there may be certain underlying principles which determine the *sizes* of settlements in an area, the *numbers* of settlements in each size-class, the *pattern* shown by settlements of different size, and the *area* that they influence and from which they draw their trade. These principles have

been brought together in a general statement referred to as "Central Place Theory" (Christaller, 1966).

The aim of this paper is to examine the fundamental aspects of Central Place Theory, testing them against the real world of Shropshire and the immediately adjacent parts of Powys and Herefordshire, in order to determine the extent to which theory can explain the actual characteristics of settlements in a rural environment. In addition it is hoped that the analytical methods reviewed and applied here will be useful elsewhere, for it is only by repeated testing in different localities that theories can be validated.

A REVIEW OF CENTRAL PLACE THEORY

Although Central Place Theory was first put forward in 1933 under the title "Die Zentralen Orte in Süddeutschland" it was not fully adopted into the mainstream of geographical thought until its publication in English (Christaller, 1966).

Couched purely in economic terms, the theory attempts to explain the sizes, numbers, functions and locations of settlements, with implicit reference to the ways in which they are linked and interact one with another. As with any model, the complexity of the real world is simplified by excluding variables which are thought to be of minor importance whilst focusing attention on those of greatest significance. In this case, economic factors are considered to be paramount in shaping the pattern. Assumptions are therefore made at the outset to exclude other variables of lesser significance or of only local relevance. Firstly, physical features are eliminated by assuming an *isotropic* land surface—a featureless uniform plain presenting no barriers to movement and with transport costs equal in all directions. Secondly, settlements are assumed to function solely as *central places,* their economic role being that of providing goods and services for a surrounding rural hinterland or *complementary region.* Thus no account is taken of any other function, such as industrial activity or the residential role of a commuter village. Thirdly, the central place model is based upon *normative* economic theory whereby Man is considered to have perfect knowledge and always to make economically rational decisions. Consumers are assumed to have complete information on the availability of goods and services in the landscape and, in seeking to minimise transport time and cost, always to visit the nearest centre supplying the goods sought. Given these assumptions, together with certain other economic concepts governing the supply of and demand for goods and services, the central place model may be developed in a series of logical steps.

In a physically uniform landscape, the initial population distribution is considered to be in equally-spaced nucleated settlements (Fig. 1).

Perfectly equal spacing can only be achieved by locating settlements at the intersections in a net of equilateral triangles. Each settlement, once formed, will generate a demand for goods and services which will, in turn, be satisfied by entrepreneurs in locations which are accessible to a sufficiently large population such that the enterprise is economically viable. The threshold population for the viable retailing of such everyday goods as foodstuffs (termed *low order* goods) will be low because this trade is both regular and frequent. Even small settlements will tend to acquire these low order functions.

More specialised, *higher order,* functions will be characterised by less frequent use such that their associated higher thresholds will require them to be accessible to a

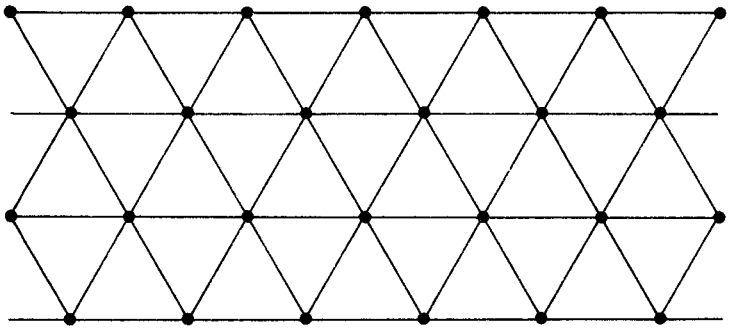

FIG. 1.

Equidistant settlements located at the intersections of a net of equilateral triangles.

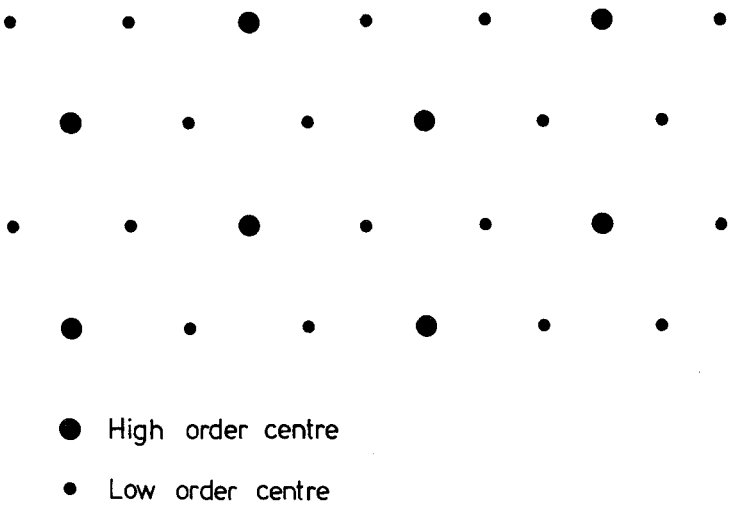

FIG. 2.

The spacing of high and low order centres.

larger population. The provision of higher order functions will therefore be confined to those centres where the combination of a larger population and the trade from surrounding lower order centres allows the necessary threshold to be achieved. It follows that higher order functions, being available only at a few widely-spaced locations, will draw trade from a greater area than the more generally available low order functions whose *range* is far more limited. If demand for higher order goods is to be met by an accessible source of supply, and if competitive factors prevent centres from developing in close proximity to one another, higher order centres will develop in a regular pattern across the landscape (Fig. 2). Their market areas (complementary regions) can be drawn in as circles whose radii correspond to the range of the highest order function present (Fig. 3). But circles will either overlap or leave gaps so the central place model modifies them into the nearest geometric form that will pack together—a system of nesting hexagons.

When yet higher order goods are introduced into the central place system successively higher order centres are generated, each with a more extensive market area created by the provision of additional functions with larger ranges which allow the

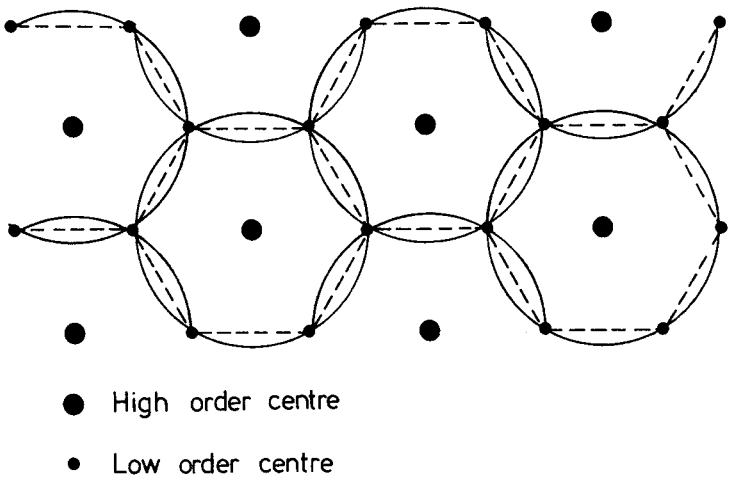

FIG. 3.
Overlapping market areas (circles) and their resolution into hexagons.

centre to achieve its necessary threshold. It should also be noted that the resident population of the larger centres must rise as more and more services agglomerate, and this will assist the attainment of thresholds for still higher order functions. Fig. 4 illustrates a central place model developed to the fifth level. The resulting system is characterised by a hierarchy of settlements; each level being distinguished by a particular frequency of centre, a certain type and number of service functions, and a specific size of market area. The settlement pattern is not only highly structured in a functional sense but also exhibits a high level of spatial order and regularity.

A centre of any particular order is seen to be supplying the demand of its resident population plus some of the demand from the six centres of the next order down located at the margins of its hexagonal market area. The theory considers that the demand from any one of these six peripheral centres is split three ways between the three nearest higher order centres (Fig. 5). The total demand supplied by the higher order centre may thus be computed as 1 (the centre itself) + 6 × $\frac{1}{3}$ (a one-third share from each of the six peripheral low order centres) = 3. This value is referred to as the *k-number* for the model. Alternative k-numbers may be derived by reconstruction of the hexagonal net of trade areas. For example, by placing the hexagons so that centres lie in the middle of the sides rather than on the corners of the hexagons, any centre will lie equidistant between two (rather than three) centres of the next highest order: its high-order demand being thus split two ways (Fig. 6). This gives a k-number of 4.

The two models differ both in their spatial arrangement and in the frequency of centres at any level. In the k = 3 model, at each lower order, the frequency of centres increases by a factor of three (1, 3, 9, 27, 81 etc.) whilst frequencies in the k = 4 model show a fourfold progression (1, 4, 16, 64, 256). Fig. 7 shows the spatial arrangement of a k = 4 model developed to the fifth order. It may be seen that larger centres become located on a system of radial routes focused on the fifth order centre, a feature that is less evident in the k = 3 model (Fig. 4). k = 4 is thus sometimes referred to as the "transport model", where the development of routeways complements the purely marketing concepts of the k= 3.

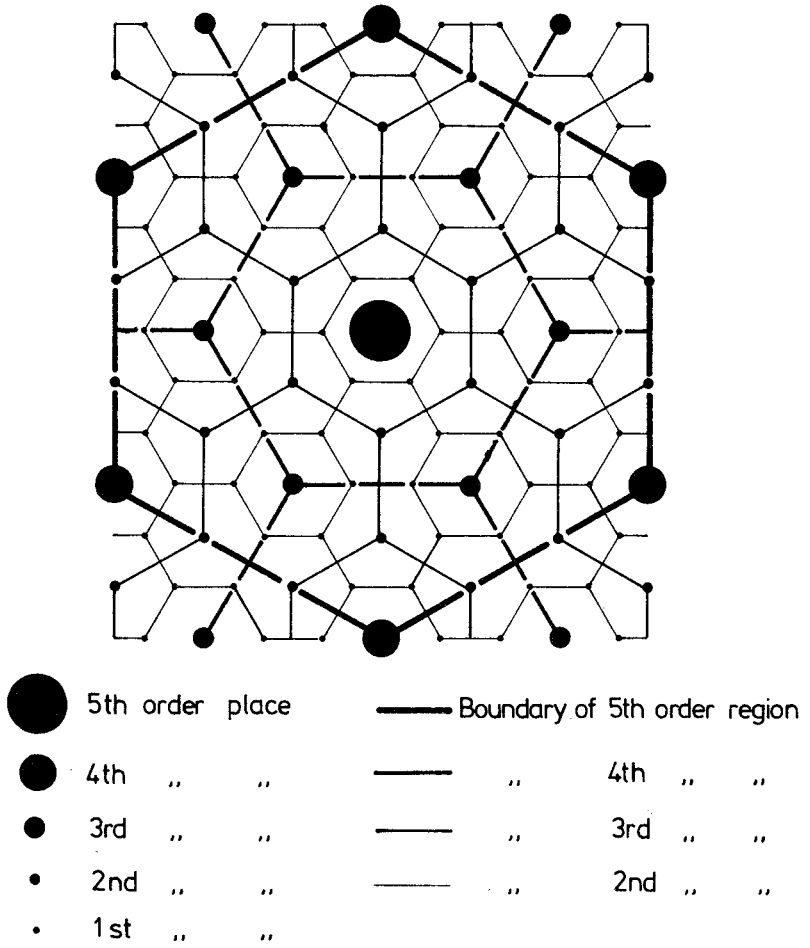

FIG. 4.

k=3 Central Place Model for five orders of centre.

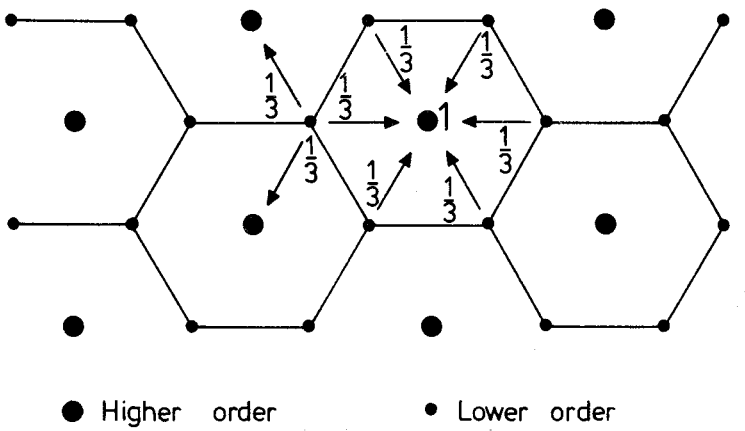

FIG. 5.

Allocation of demand in a k = 3 model

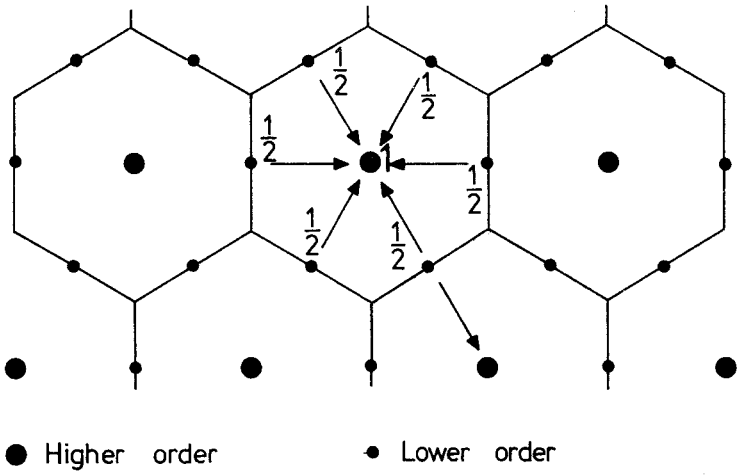

FIG. 6.
Allocation of demand in a k = 4 model

It would be naive to expect any real settlements to correspond exactly to the Christaller model in either its hierarchical structure or its spatial pattern because of the inherent assumptions involved (p. 260). But if the economic processes underlying central place theory have played some part in shaping the settlement pattern some of the following characteristics should be apparent:-

(i) a hierarchical structure to the settlement system with distinct levels in terms of population size and functional status.

(ii) an increasing frequency of centres at each lower level in the hierarchy.

(iii) a distinctive amount of service provision at each settlement level: the highest level supporting all orders of functions, and with progressive elimination of higher order functions at lower levels.

(iv) a contraction of trade area associated with decrease in functional status.

(v) some degree of spacial regularity comparable to a central place structure. Further elaboration on these basic points is provided by Lewis (1977).

In testing the model these features may be taken as a set of working hypotheses. The following sections provide a case study of the central place model in Shropshire and the immediately adjacent centres in the Welsh Borderland.

METHODS AND SOURCES OF DATA

The following information is required in order to test the central place model:-

1. The population of settlements in the study area
2. Some measure of the number and types of functions available in the centres—retail, service and administration.
3. Indications as to the extent of the market area of each centre.
4. The spatial pattern produced by centres of different sizes.

1. Population Data

Population figures, based on the county census reports, may be used as a surrogate measure of central place status provided that the functional importance of

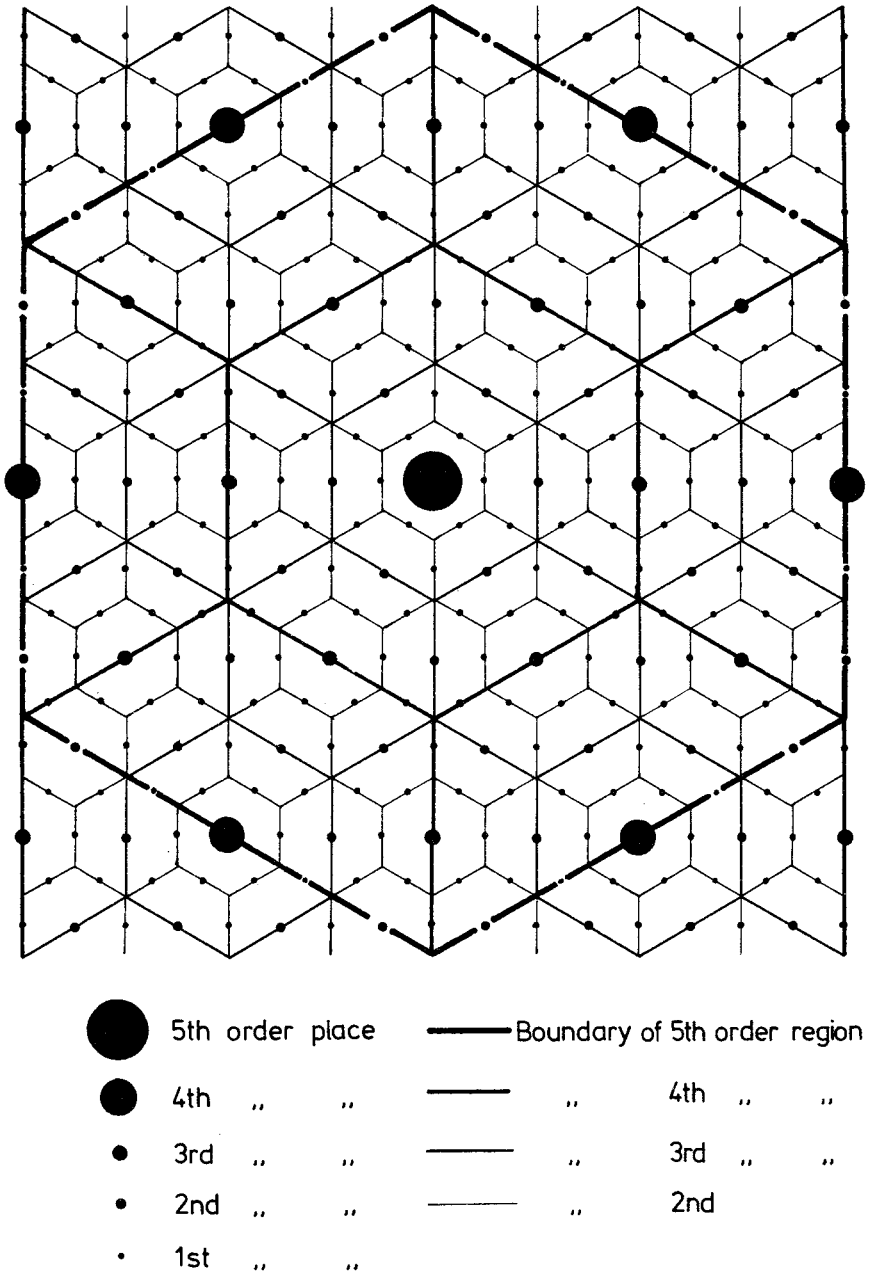

FIG. 7.

k = 4 Central Place Model for five orders of centre

a centre is closely correlated with the size of its population. If population is plotted against rank of population for a sample of centres the hypothesis of a settlement hierarchy will be confirmed by the presence of a "stepped" plot rather than of a continuum. Population data thus provide a rapid and readily available source for a preliminary investigation of any hierarchical structure.

There are, however, limitations inherent in the county census data which summarise the total population in each parish at ten-yearly intervals. The present study was completed in 1978 but the most recent census was taken in 1971. Population changes during those seven years were assumed to be small except in the case of Telford New Town, where a revised figure of 97,000 (based on current Development Corporation estimates) was used in place of the 76,000 of the 1971 census.

A further problem arises with very small settlements. The published figure aggregates all settlements within each parish. Many parishes comprise not only the village from which the parish takes its name, but one or more other nucleations—some of which may be larger than the original settlement. Pontesbury, for example, contains no fewer than 8 other named nucleations. Whilst in Hopesay parish the village of Hopesay has been eclipsed by the growth of Aston-on-Clun which has become the more significant settlement, both functionally and in terms of population size.

No attempt was made, in the present study, to estimate the population of individual centres within parishes. It might be possible to estimate these figures by multiplying the number of houses in particular settlements by the mean number of occupants per household for that parish (obtained from the census data).

2. Functional Status

Some previous central place studies have concerned themselves solely with retail establishments (eg. Davies, 1967) whilst others have considered a wider coverage of central place activities (eg Berry and Garrison, 1958). In their fullest sense, central place functions encompass economic, social and administrative activities and the present study was based on a very broad interpretation of a settlement's role by distinguishing all the components listed in Table 1.

The number of establishments in each class of function was obtained by thorough field surveys in each of the 497 settlements within the sample during 1978. Some categories are more amenable to field survey data collection than others. Retail establishments are readily located but certain service professions, such as solicitors and doctors, are less easily identified. In such instances the field data were

Table 1. *Functional classification used in the survey, frequency of occurrence of each class and location co-efficient*

Functional class	Frequency in sample	Location co-efficient
Churches and chapels	541	0.185
Pubs and hotels	699	0.143
Post offices	197	0.508
Low Order Retail	1127	0.089
High Order Retail	1200	0.083
Garages and Transport services	480	0.208
Agricultural services	196	0.510
Construction services	251	0.398
Social/recreation/entertainment	233	0.429
Schools	316	0.316
Doctors (hours of surgery per week)	1267	0.079
Banks and Building Societies	216	0.463
Professional Services	252	0.397
Cafe/Restaurant/Take away	227	0.440
Miscellaneous Commercial services	612	0.163
Miscellaneous Public services	397	0.252

supplemented by documentary sources including:- the Telephone Directory Yellow Pages; local authority departments; the area health authority; and the emergency services.

Documentary sources in isolation will rarely produce a complete set of functional data. Trade Directories, for example, whilst providing an invaluable source of historical data no longer deal adequately with small rural settlements. The Yellow Pages are not complete for all the central place categories used, and may only indicate the telephone exchange area rather than the true settlement.

The functional classification employed (Table 1) is by no means all-embracing; the classes themselves are extremely coarse and include a diversity of specific functional types. Retail activity, for example, has been grouped into two categories: "low order" outlets, including all types of foodshops, chemists, newsagents, tobacconists, village stores and general dealers, and "high order" outlets which comprise the more specialised shops usually retailing some kind of durable goods. In this classification, retailing is considered as one component of the much broader panorama of service functions offered by a central place.

Difficulties arise in equating premises of the same type but of vastly different scale, and with establishments offering a range of different goods. Telford hypermarket offers an extreme example, with its variety of high and low order goods. This problem was overcome by recording the establishment on each type of retail goods offered. In other studies alternative weightings have been applied to take account of differing scales of operations based on number of employees or floorspace. Doctors' surgeries present something of a problem in that the quantity of service provided in the establishment varies from a full-time group practice to a part-time surgery operating for one hour a week. In this case figures for the total hours of surgery time per week were obtained from the Area Health Authority.

The *functional index* (FI) of each settlement was calculated to provide a single overall figure of functional status, using the method of Wayne Davies (Davies, 1967; Lewis, 1977). This entails first totalling the number of establishments in each class of function for the whole sample (see Table 1). Functional classes with a high overall frequency are considered to be of less importance than infrequently occurring types. Each function is therefore ascribed a weighting or *location coefficient* (LC):-

$$LC_t = \frac{1}{T} \times 100$$

where LC_t = location coefficient of function t
and T = the total number of outlets of function t in the study area.
For each centre, the functional classes are considered in turn and a *centrality value* (CV) determined by multiplying the number of establishments in a particular functional class by the LC of that class.

For example:-
Shrewsbury has 81 of the 699 pubs recorded in the study area.

The LC_{pubs} is thus $\frac{1}{699} \times 100 = 0.143$

The CV in Shrewsbury for pubs is thus $0.143 \times 81 = 11.58$. Or, expressed another way, Shrewsbury has 11.58% of the total number of pubs in the study area.

Table 2. *Centrality Values and Functional Indices for the main centres wit*

Centre	Churches & Chapels	Pubs & Hotels	Post Offices	Low Order Retail	High Order Retail	Garages & Transport	Agricultural Services	Construction Services
Shrewsbury	5.36	11.58	7.11	13.17	26.97	13.73	9.18	13.13
Telford	5.74	14.59	6.10	13.80	13.94	16.22	8.16	28.66
Oswestry	4.63	2.43	1.52	6.32	9.71	7.28	6.63	4.38
Market Drayton	1.29	2.15	1.02	3.65	5.15	4.58	5.61	1.59
Ludlow	0.74	2.86	1.02	4.18	6.00	2.29	3.06	3.58
Newport	1.48	2.15	1.02	2.40	2.49	4.37	3.06	8.76
Welshpool	1.85	3.29	0.51	2.67	4.40	3.32	4.59	3.58
Bridgnorth	0.74	3.86	1.02	3.47	5.31	3.32	2.04	2.79
Whitchurch	0.93	3.30	0.51	3.12	5.40	1.87	1.02	3.18
Ellesmere	0.56	1.43	0.51	2.14	2.07	1.04	2.55	0.40
Shifnal	0.37	1.86	0.51	2.40	2.32	0.62	2.55	0.80
Wem	1.11	1.43	0.51	1.60	2.24	1.04	2.04	1.99
Tenbury Wells	0.57	1.14	0.51	1.78	1.74	0.62	2.04	1.59
Knighton	0.57	1.00	0.51	1.78	1.57	1.04	2.55	0.79
Albrighton	0.37	0.57	0.51	1.87	1.83	0.62	1.02	1.59
Church Stretton	0.37	0.57	0.51	1.42	1.41	0.62	1.53	1.19
Craven Arms	0.37	0.29	0.51	1.25	0.83	1.04	5.10	1.59
Broseley	0.74	1.29	0.51	1.78	1.24	1.04	1.53	1.59
Much Wenlock	0.56	1.00	0.51	1.69	0.50	0.62	1.53	1.19
Cleobury Mortimer	0.56	1.29	0.51	1.07	0.66	0.62	2.04	1.19
Bishops Castle	0.37	1.00	0.51	1.60	0.91	0.83	1.53	0.40
Montgomery	0.56	0.86	0.51	0.71	0.33	0.62	0.00	0.40
Highley	0.56	0.28	0.51	0.99	0.66	0.42	0.51	0.40
Bayston Hill	0.56	0.57	0.51	1.51	0.25	0.42	1.02	0.00
Pontesbury	1.11	0.72	0.51	0.62	0.08	0.42	1.02	0.40
Gobowen	0.56	0.57	0.51	1.16	0.17	0.42	1.02	1.19
Clun	0.37	0.29	0.51	0.53	0.25	0.42	0.51	0.40
Shawbury	0.19	0.29	0.51	0.45	0.17	1.53	0.00	0.00

* Correlation coefficient not significant at 95% confidence level.
For centres with FIs below that of Shawbury CV arrays contain too many zeros to permit correlation.

Social Rec. Entertainment	Schools	Doctors	Banks & Bldg. Socs	Prolessional Services	Cafe Rest. Take-away	Misc. Commercial Services	Misc. Public Services	Functional Index	Correlation coefficients between CVs of adjacent ranked pairs
18.88	12.96	15.68	18.98	25.80	23.32	30.48	11.84	258.17	
									+0.33*
9.87	17.70	23.21	18.05	13.90	14.96	17.93	5.04	227.88	
									+0.22*
5.15	5.06	5.57	5.09	7.54	8.80	9.62	3.78	93.51	
									+0.75
2.15	2.21	2.53	5.09	6.75	3.96	5.05	2.27	55.07	
									+0.76
1.29	1.90	2.33	6.02	9.13	4.84	2.77	2.77	54.78	
									+0.52
1.72	3.16	2.45	4.17	6.75	2.64	3.10	1.26	50.98	
									+0.46
2.57	1.26	2.13	5.09	3.97	2.64	4.56	2.26	48.69	
									+0.57
2.15	2.53	3.12	6.95	2.78	3.96	1.96	2.26	48.26	
									+0.54
4.72	1.90	3.24	3.24	3.57	5.28	3.91	2.52	45.19	
									+0.35*
1.29	0.95	2.37	4.17	1.99	2.20	2.121.77	27.55		
									+0.49
2.57	1.26	3.52	1.39	2.78	1.76	0.98	1.77	27.46	
									+0.46
2.57	1.58	1.03	1.39	2.38	2.20	1.69	1.77	26.57	
									+0.50
1.29	0.95	1.46	1.86	0.80	2.20	1.30	1.77	21.56	
									+0.92
1.29	0.63	1.94	2.30	0.80	0.88	0.65	1.77	20.07	
									+0.45
1.29	0.95	1.81	1.85	1.98	1.76	0.82	0.50	19.34	
									+0.72
0.43	0.63	2.05	1.39	3.18	1.32	0.98	1.01	18.61	
									+0.48
0.86	0.32	1.03	1.39	2.32	0.88	0.49	0.00	18.25	
									+0.41
0.86	1.26	1.03	0.92	0.79	1.32	0.81	0.55	17.26	
									+0.54
0.86	0.63	0.87	1.39	1.19	1.32	0.97	1.01	15.85	
									+0.55
1.29	0.63	1.58	1.85	0.40	0.88	0.49	0.50	15.56	
									+0.48
1.29	0.63	0.84	0.93	1.19	1.32	0.49	0.50	14.39	
									+0.18*
2.15	0.32	1.15	0.93	0.40	0.44	0.16	0.76	10.30	
									+0.78
2.15	0.63	0.91	0.46	0.00	0.44	0.32	0.51	9.75	
									+0.62
1.29	0.32	0.87	0.93	0.00	0.88	0.00	0.25	9.38	
									+0.49
0.86	0.63	0.74	0.93	0.00	0.00	0.16	0.25	8.42	
									+0.44
0.43	0.32	0.12	0.46	0.00	0.44	0.00	0.51	7.35	
									+0.42
0.43	0.32	0.87	0.93	0.00	0.44	0.16	0.51	6.94	
									+0.24*
0.00	0.63	0.94	0.46	0.00	0.00	0.82	0.51	6.50	

Finally the CVs for all classes of functions are summed to give the functional index (FI) for each centre: a generalised measure of service provision in the settlement. The results are shown in Table 2.

3. Market Area

If it is possible to identify a structured system of central places in the landscape it should also be possible to recognise complementary regions (market areas) around those centres within which the population looks to the main centre for its important goods and services. Attempts to define these spheres of influence have followed one of three lines of approach:- theoretical, direct and indirect.

a. *theoretical*

Reilly (see Tidswell, 1976: Everson and Fitzgerald, 1969) used an analogy from Newtonian physics in order to define the pull a centre should exert over the surrounding area and its competing centres. "Reilly's Law of Retail Gravitation", as it has come to be known, states that:- "Two centres attract trade from intermediate places in direct proportion to the size of the centres and in inverse proportion to the square of the distances from these two centres to the intermediate place."

Consider, therefore, a town A located between two larger towns, B and C. The trade from A will be divided between B and C in a manner proportional to the size of B and C but inversely proportional to the square of the distance AB and AC respectively, i.e.:

$$\frac{\text{The volume of A's trade to B}}{\text{The volume of A's trade to C}} = \frac{\text{Population of B}}{\text{Population of C}} \times \frac{(\text{Distance AC})^2}{(\text{Distance AB})^2}$$

As in the law of gravity, the "pull" of a body increases linearly with its mass but decreases with the square of the distance. A modification of Reilly's law can be used to predict the boundary of trade areas between neighbouring centres—what is sometimes referred to as the 'breaking point'. The distance of the breaking point (Bxy) from the smaller of two centres, x and y is:-

$$\text{B}\,xy = \frac{\text{distance } xy}{1 - \sqrt{\dfrac{\text{population of } x}{\text{population of } y}}}$$

Note that population is here being used as a substitute for functional status, thus assuming that the two variables are closely correlated.

b. *direct*

Direct methods of defining market areas invariably involve a consumer survey (questionnaire) either to determine the place of origin of shoppers in a centre, or to determine which towns are used for various functions amongst a sample of rural dwellers (Bracey, 1953). Plotting the responses from a High Street questionnaire will give a broad picture of that centre's sphere of influence. However, such data show a high degree of temporal variation depending upon the time of day, season, weather and day of the week. In the present study interviewing was carried out on a sample of Saturdays between May and October, avoiding the lunch hour.

c. *indirect*

Indirect methods were not used in the present study but entail mapping the trade areas for a range of functions. For example, the distribution areas of bakers, the catchment areas of schools and the extent of postal districts.

These methods will tend to indicate the maximum extent of market areas and, unlike Bracey's more sophisticated treatment, give no indication of the variation in market areas for the different orders of goods and services.

The Study Area

The study area encompasses the county of Shropshire, together with immediately adjacent parts of Herefordshire and Powys (Fig. 8). Inspite of the practical necessity of defining a study area, no assemblage of settlements forms a closed system. Peripheral centres are functionally linked to others outside the study area. To have taken the county alone would have been excessively arbitrary because trade movements show little respect for political divisions between counties, or even between England and Wales.

Superficially, the drift-covered North Shropshire Plain might appear to satisfy Christaller's assumption of an isotropic surface. But even here upstanding hills of the under-lying Permo-Triassic rocks produce sharp escarpments in the Nesscliff, Grinshill and Weston areas, whilst the legacy of Irish Sea Glaciation creates diversity elsewhere in the form of meres, extensive peat mosses, kame and esker features, and moraine ridges—particularly in the vicinity of Ellesmere (Worsley, 1970).

Any notion of physical uniformity in south Shropshire must be abandoned as a result of the exceptional geological diversity. Plateaux, ridges and escarpments, often of ancient and resistant lithology, cross the county with North-South or Northeast-Southwest strikes. To the west, the moorland plateaux of the Stiperstones and the Long Mynd rise to over 500 m. Along the eastern flank of the Long Mynd runs the narrow, fault-guided Church Stretton valley providing a natural routeway from the northern plain through the southern hills. Pre-cambrian volcanic rocks form the Stretton Hills, which rise sharply to the east, while farther southeast lies the gentler scarp and vale topography of Ape Dale, Wenlock Edge and Corve Dale with the higher Clee Hills beyond. In the southwest of the study area the dissected hill country of Clun Forest is a further distortion of the physical monotony assumed in Christaller's original concept.

The historical development of Shropshire settlements is also of considerable relevance to any theoretical central place approach. Rowley (1972) cites the numerous attempts to stimulate settlement and trade at many points in the Shropshire landscape since Norman times. Classic examples are the castle towns, such as Shrewsbury, Montgomery, Clun, Bishops Castle and Ludlow, where the initial defensive structures were soon followed by the creation of planned towns with market charters to stimulate trade and commerce, and to exert economic power over their surroundings. Only a handful of the medieval boroughs survived to become the greater or lesser market towns of later centuries. It is often apparent that those located too close to existing centres of trade, and those sited in sparsely populated country failed to survive as significant market centres. Growth or demise has had as much to do with central place concepts as with historical events.

Christaller's assumption concerning the central place function of settlements is

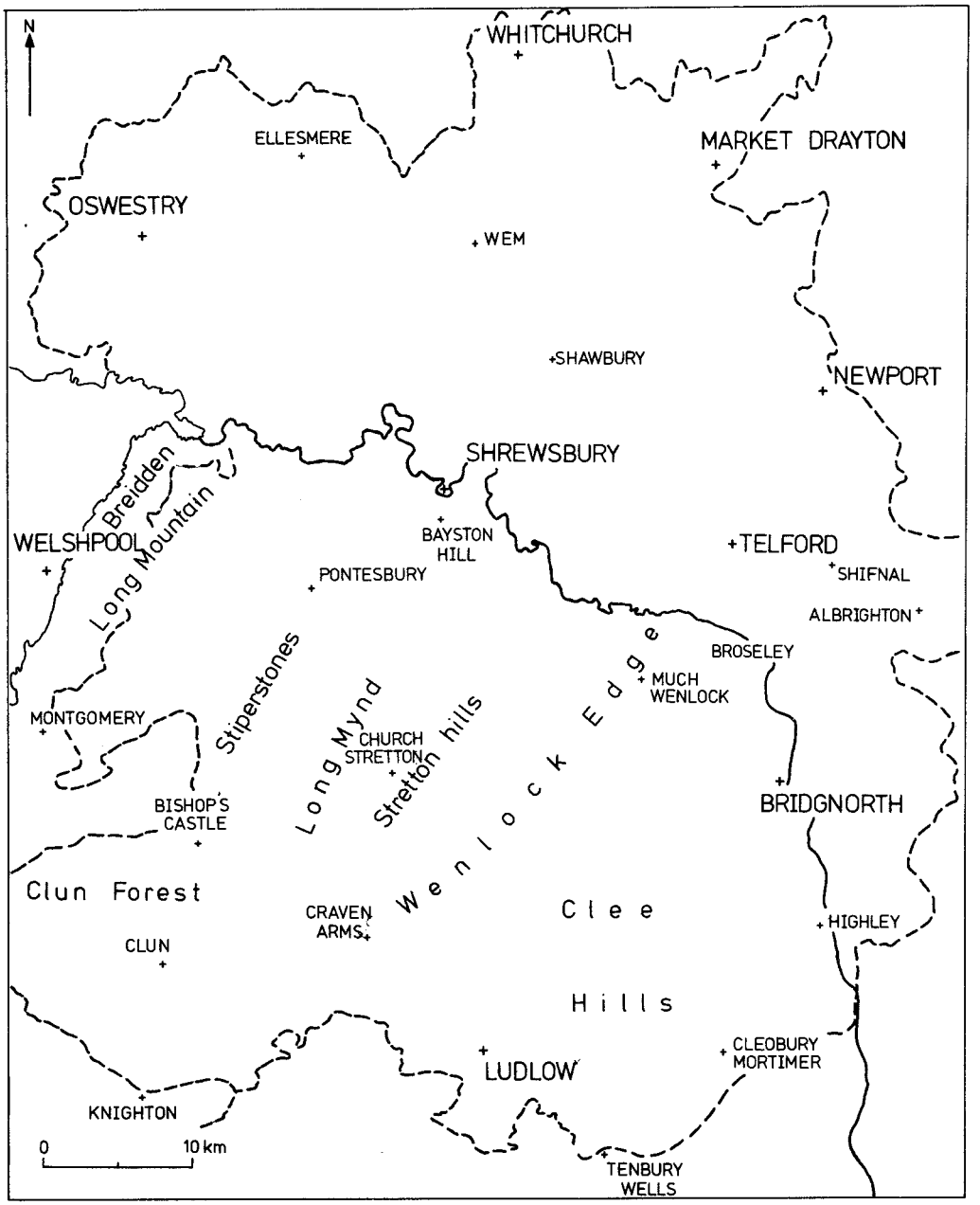

FIG. 8.
The study area

also only partially valid in the study area. Even the traditional market centres no longer function solely as trading and service towns. Most offer considerable employment in light industrial activity, particularly clothing and engineering, whilst special reference must be made to those settlements where manufacturing or extractive industry was the main stimulus to their early growth and is still the dominant

activity. The designated area of Telford New Town incorporates old industrial settlements which owe their origin to the coal, iron ore, limestone and clay resources of the Shropshire coalfield and Ironbridge Gorge. Places such as Coalbrookdale, Ironbridge, Ketley, Madeley, Dawley, Oakengates and Wellington, with their eighteenth and nineteenth century histories of extractive industry and iron manufacture, form a different pattern of settlement to the "true" central places. The New Town itself, based on the regeneration of the old industrial settlements is equally at odds with Christaller's assumptions although, despite its origins, it cannot be ignored as a central place. Its large scale retail enterprises draw custom from far beyond its urban limits.

Results and Discussion

The Functional Hierarchy

In Fig. 9 the Functional Indices are plotted on a log scale against rank of FI, on a normal scale, for all the centres in the sample area. The existence of a functional hierarchy is indicated by steps or breaks in the plot. Even by this subjective method a hierarchy is evident amongst the twenty or so larger settlements. Below them there is a continuum of centres showing progressively decreasing importance from Montgomery (FI = 10.4) down to a group of seventy very small centres with none of the functions listed in the classification, i.e. FI = 0.

Whilst it is easy to see that a hierarchy exists amongst the larger centres, there are problems in defining precisely where the breaks occur. Oswestry occupies a somewhat isolated position on the graph. Is it sufficiently distinct from the other market towns (Market Drayton, Ludlow, Newport, Welshpool, Bridgnorth and Whitchurch) to be classified separately? Of the smaller centres in the next group of twelve, are the first three significantly more important than the remaining nine?

Such questions require the application of an appropriate mathematical technique. Davies (1967) suggested a simple method which entails taking the complete array of CVs for each centre and comparing them with the CVs of the centre with the next highest FI. Calculation of a correlation coefficient (see Ebdon, 1977) will indicate the degree of similarity between the two centres, a value of 1.0 showing perfect correlation. A positive coefficient in excess of 0.40 indicates a significant correlation between the two CV arrays at the 95% confidence level (16 functional classes). A coefficient below this figure is accordingly taken to indicate a significant difference in the numbers and types of functions at the two centres and thus determines a break in the hierarchy.

The top fifty centres are listed in rank order of their FIs in Table 2, together with their CV arrays and the correlation coefficients for each successive pair of centres. The structure of the resultant hierarchy is detailed in Table 3.

Shrewsbury and Telford have rather similar FI values, but the CV correlation coefficient of 0.33 highlights the marked differences in the types of service provision between the traditional county town and the industrially-based new town. In the retail categories both centres show a similar level of low order provision, but Shrewsbury has twice Telford's complement of high order shops. Similarly Shrewsbury far outstrips Telford in the public, professional and general commercial service classes. Telford, on the other hand, has a greater representation in the fields of construction, garage and transport services.

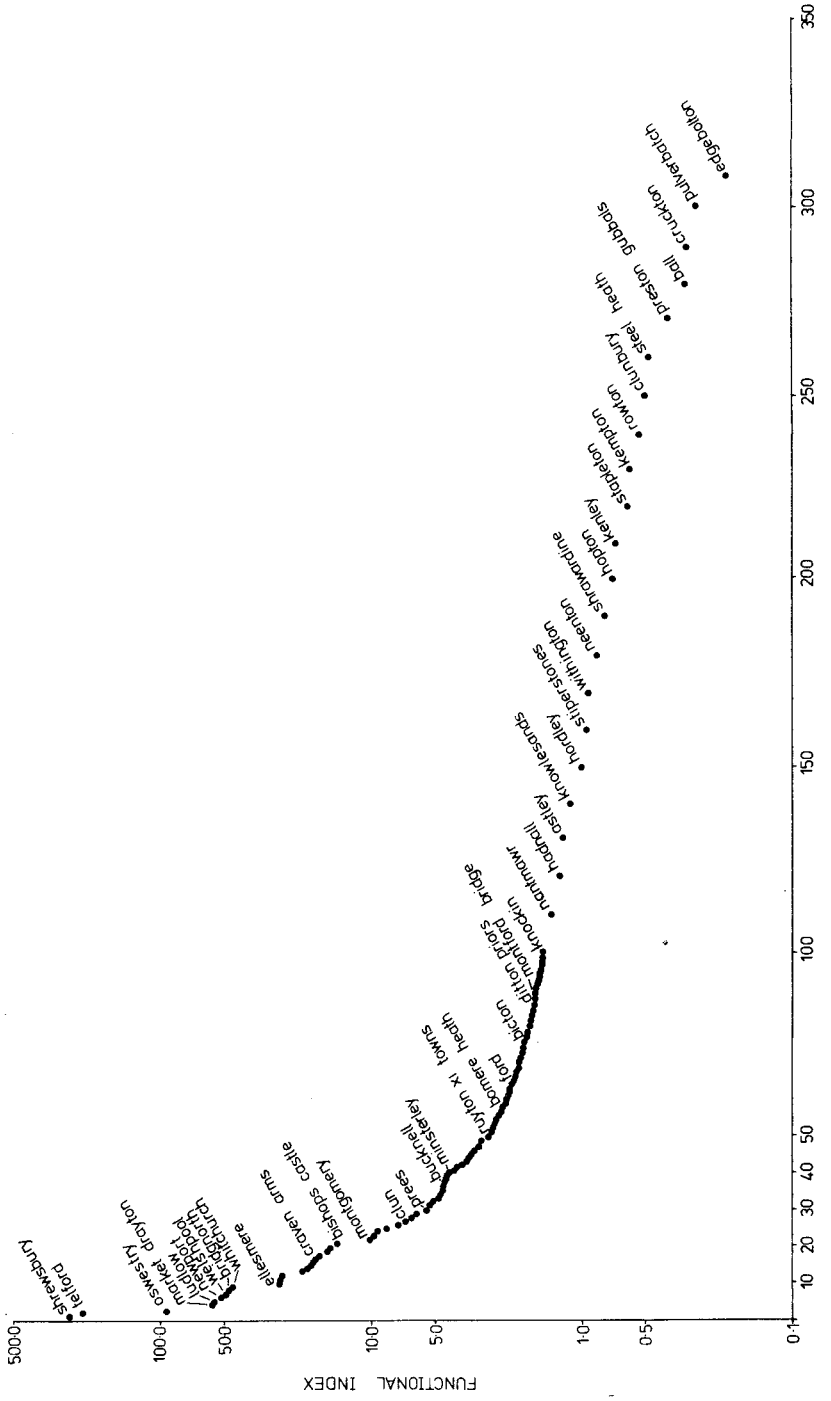

FIG. 9.

Functional indices of centres against rank of functional index. In addition there are 90 centres of FI=0.19 (church only), 37 centres of FI = 0.14 (pub only) and 70 centres of FI = 0.0 (none of the classified functions).

Table 3. *Frequency of Centres at each level in the hierarchy*

Settlement Order	Number of Centres	Median FI
5A	1	285.19
5B	1	227.84
4	7	50.95
3	12	19.00
2	6	9.03
1	469	0.39

The marked drop in FI from Telford to Oswestry (CV correlation + 0.22) defines a major break between the two Centres. Oswestry obviously correlates strongly (+ 0.75) with Market Drayton, despite its higher FI, to head an otherwise extremely close group of seven market towns. All are significant shopping centres with weekly retail and livestock markets. Most have administrative responsibility at District level, and a full compliment of services in the professional, educational and health service sectors. Though lacking some of the specialisms of Shrewsbury, they are still the mainstay of everyday economic and social life for their particular districts. Apart from Welshpool, they also have rather similar historical origins being either Norman castle towns (Ludlow, Bridgnorth, Oswestry) or medieval boroughs. Their townscapes frequently bear the imprint of the planned town—the gridiron street plan and the long narrow buildings. They often include many timber-framed structures on the old burgage plots.

These seven important market towns are significantly distinct from the next level in the hierarchy, a group of twelve centres: the smaller market towns of Ellesmere, Shifnal, Wem, Tenbury Wells, Knighton, Church Stretton, Much Wenlock, Cleobury Mortimer and Bishops Castle together with the more recent additions (or expansions) of Albrighton, Craven Arms, and Broseley. Most have some representation in all sixteen functional categories but the distribution of CVs differs from those of higher grade centres. With the exception of Wem and Albrighton, the CVs are greater for low order than for high order retailing. As the size of centre decreases and its trade area diminishes there is a failure to meet the threshold for certain high order functions. Certain specialisms are evident within the group. Craven Arms was merely a coaching inn and small township within the parish of Stokesay until the improvement of turnpike roads in the area and the later creation of the railway junction. Its dramatically increased accessibility, together with the absence of any other established service centres nearby, brought about rapid nineteenth century growth and today the town has a wide range of agricultural service activities including a major livestock market.

Bishops Castle is decisively separated from Montgomery (+ 0.18), which heads a small group of six centres of diverse historical origins. Within this group are Montgomery itself and Clun, both originally Norman castle towns, neither of which has grown much beyond its medieval limits. Montgomery provides the classic case of a former county town which has been economically eclipsed by the growth of a new neighbour, Welshpool, where canal and railway access stimulated trade. Clun appears never to have achieved the economic status of the other castle towns strategically positioned in the borderland; its proximity to Bishops Castle is possibly significant. The four other centres, sandwiched between Montgomery and Clun,

have quite different histories. These are Highley, Bayston Hill, Pontesbury and Gobowen. These commuter villages, usually grown up around ancient village sites, have close functional links with nearby towns. Service provision has increased with the greatly inflated population but their functions are predominantly of a low order nature in view of their connections with a higher order centre nearby.

This leaves the long tail of four hundred and sixty-nine "first-order" centres, forming a continuum with no distinct breaks. The group shows great diversity from large villages, such as Bucknell, with a full range of low order functions to the many tiny clusters of houses at road junctions, where a public telephone or postbox are the only service functions. Considering the many variables which affect village economy it is scarcely surprising to find a continuum rather than a hierarchy. Central place notions based on distance from surrounding centres lose significance when local factors are taken into account. The villages with higher FIs are those whose populations have been boosted by local development: armed forces camps as at Shawbury and Prees, local industries such as creameries as at Minsterley and Ruyton-XI-Towns, or a trading estate as at Ditton Priors. Despite their substantial population, commuter villages rarely assume the FI that their population would suggest. Basic services, such as public house, foodstore, post office, butcher and hairdresser will develop if the centre is far enough from Shrewsbury. Proximity to that town, combined with a mobile and affluent population appears to check the growth of service functions. Bicton, for example, lying 4 km from the centre of Shrewsbury has only a church, a school, a village hall, a pub, garage and café despite an extensive residential estate. Ford, nearby, has a post office, butcher, general store and a second pub in addition despite a more limited residential development. Here the type of housing is perhaps relevant; the less mobile occupants of local authority rather than private housing appear to generate a greater demand for services in Ford than in Bicton.

Location on a main road may also stimulate service functions, even in small settlements. "Roadhouse" pubs, restaurants, cafés, garages (often combined with low order retailing), antique or craft shops, and caravan sales are characteristic of main route villages like Montford Bridge, Nesscliff, and West Felton on the A5 west of Shrewsbury. Some roadside services are often in isolated locations away from any settlement. This is but one example of how a highly mobile society conflicts with basic central place concepts: demand is no longer focused solely on the central places but also spreads out along the routes which link them.

Of the 469 first order settlements, 90 have only a church (FI = 0.185), 37 others have only a pub (FI = 0.14) and seventy have none of the services included in the survey (FI = 0). Many of these small settlements do have public telephones and postal collections, functions which arguably represent the lowest order of central place provision. The population of these numerous virtually unserviced villages presumably fails to reach the threshold necessary to sustain a shop, post office or primary school. Certainly many remoter parishes have experienced progressive depopulation over several decades, including the period 1961-1971, but this is perhaps only a partial explanation for lack of services. The closure of 118 schools (excluding amalgamations) during the period 1947-1977, often in response to falling numbers on the register, reflects an ageing (rather than a declining) rural population corresponding to the period of marked contraction in agricultural employment. The closure of 32 village post offices since 1969 reflects the absence of

any younger successor to take over from a retiring postmaster rather than any decline in trade.

The continuing decline in the level of rural service provision in many villages is thus related to fundamental changes in the social, demographic, and economic structures of rural communities. The relative importance of the many possible factors—such as the past influence of manorial control or the effects of present-day planning—affecting the functional status of a village present considerable scope for further study.

Frequencies and Spacing of Centres

A functional hierarchy, similar to that developed here for Shropshire, can be demonstrated in most rural areas (and, indeed, for different sizes of shopping centre within large urban areas). But many empirical studies have failed to find (or even to look for) Christaller's other predictions regarding spatial regularity and the frequency of centres of each order. When comparing observed with predicted frequencies, account must be taken of the extent, shape and position of the study area. The k3 or k4 model predicts the frequencies of centres in limitless space. By drawing a boundary around a study area an artificial closed system is created which fails to take account of the fact that a fourth order centre, such as Ludlow, may well fall within the range of Hereford as well as Shrewsbury for higher order goods and services.

In this study the predicted numbers of centres at each level have, therefore, been derived from superimposing a k3 and then a k4 model over the study area with Shrewsbury as the fifth order centre and fourth order centres located on the boundaries of the study area. The results are presented in Table 4. The predicted frequencies may be verified by simply counting the number of centres of each order in Figs. 4 and 7.

Table 4. *Observed and expected frequencies of Centres for the top three levels in the hierarchy*

Settlement Order	Observed frequency	Expected frequency (k3)	Expected frequency (k4)
5	2	1	1
4	7	6	6
3	12	10	16

Chi-squared values: Observed and expected (k3) = 1.56*
Observed and expected (k4) = 3.42*
* Not significant at 95% confidence level.

For the top three grades, the observed frequencies of 2 fifth, 7 fourth and 12 third order centres are remarkably similar to the k3 prediction of 1 fifth, 6 fourths and 10 thirds. Chi-squared tests fail to show any significant differences between observed and predicted frequencies for either k3 or k4 models.

However, there is no similar correspondence with second and first order centres. The underrepresentation of second order centres probably reflects the spurious nature of the category. It consists of two "failed" third order centres (Montgomery and Clun) and four enormously overgrown first order centres. The long tail of first order centres must represent what the models would predict to be distinct second

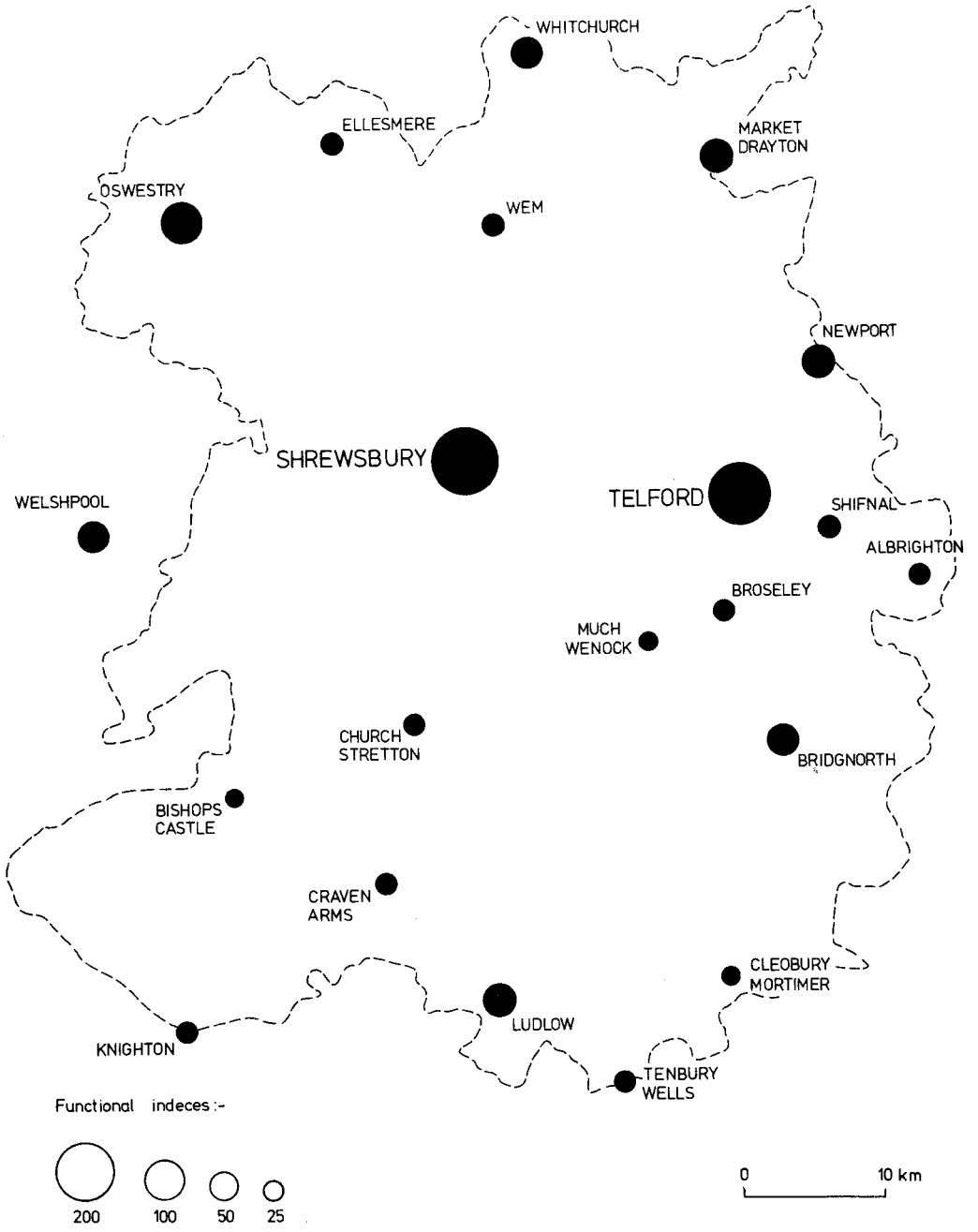

FIG. 10.

Location of the higher order centres.

and first order levels. Non central place factors have intervened to destroy the hierarchy at its lower end. Quite possibly it never developed.

Locations of the fifth, fourth and third order centres are plotted in Fig. 10. If Telford is considered to be outside the terms of reference of Central Place Theory, the distribution of the other main centres show a remarkable agreement with the

Christaller model. Fourth order centres are invariably some 30 km from Shrewsbury and maintain their distance from each other. Wider spacing in the southwest and closer spacing in the northeast probably reflects the physical distortion of the theoretical isotropic plain. Lower population densities in the Clun Forest country between Welshpool and Ludlow contrast with the more productive lands on the northern plain in the vicinity of Whitchurch, Market Drayton and Newport.

The frequencies of centres (Table 4) lends most support to a k3 model but the addition of third order centres (Fig. 10) is often closer to a k4 structure in spatial terms. Third order centres are usually located on main routes between Shrewsbury and a peripheral fourth order centre, or mid-way between two fourths: a feature of the k4 transport model. Wem, Church Stretton and Much Wenlock lie on routes from Shrewsbury to Whitchurch, Ludlow and Bridgnorth respectively, whilst Ellesmere and Shifnal lie midway between fourth order centres. There are some anomalies between predicted and actual locations but these can all be explained by local (non central place) factors. Albrighton and Broseley are obvious interlopers whose residential character is plainly in conflict with Christaller's assumptions. There are several instances where high ground has prevented the growth of third order centres, as in the Clee Hills between Ludlow and Bridgnorth, and as in the Breidden/Long Mountain area between Welshpool and Shrewsbury. The triangle formed by Shrewsbury, Oswestry and Whitchurch is one of almost perfect symmetry with the smaller market towns of Wem and Ellesmere located at the mid-points of two sides. A centre of similar status is missing from the mid-point of the third side. Instead there are two sizeable villages in close proximity to each other, Baschurch and Ruyton-XI-Towns, both medieval boroughs which failed to reach any significance as market centres. Their proximity to each other, and to the larger and longer-established towns of Shrewsbury and Oswestry is ample explanation for their failure.

Population of Centres

On central place grounds, the functional status of a centre should be closely linked to its population and the hierarchy of settlements should be distinguishable from population data alone. Other work, notably that of Zipf (see Everson and Fitzgerald, 1969), suggests that the population of settlements will not reveal a hierarchical structure, but will instead obey the 'Rank-size Rule'. This simply states that when settlements are ranked in order of size, the second ranking town will have half the population of the largest town, the third ranking town one-third the population and so on. In other words:

$$P_r = \frac{P_1}{r}$$

where P_1 = the population of the largest town
and P_r = the population of a town of rank r.
Expressed graphically a plot of population against rank of population for all towns should produce a straight line on log-log scales.

Carter (1972, p.83) goes some way towards reconciling these two ideas. He says that, whilst true central place functions may well show a stepped function among a sample of centres, if *all* urban functions (including those outside the defined central

place activities) are massed and this aggregate of functions is considered to be related to population, a continuous rank-size relationship is likely. Thus where centres' functions are predominantly retail and service (central place type) functional status will show a close relationship with population and a hierarchy of settlement populations will appear. Any factors which distort the relationship, such as the rapid growth of a commuter community or manufacturing industry, will smooth out the population hierarchy into a continuum, possibly of the rank-size rule form.

Zipf's concept was, of course, developed on a national rather than a regional scale. If the size of the sample area is extended to include very different types of centre the continuum is likely to replace the hierarchy.

Population rank-size relationships are plotted as Fig. 11. With Telford as the largest town (pop: 97,000) the rank size rule would predict populations of 48,500, 32,333, 24,250, 19,400 and 16,167 for the next five towns. The actual figures of 56,188 (Shrewsbury), 12,018 (Oswestry), 10,491 (Bridgnorth), 7,466 (Ludlow), 7,250 (Welshpool) and 7,142 (Whitchurch) depart significantly from the predictions and show a stepped (rather than straight-line) plot down to rank thirteen. There is then a continuum of population decrease, convex in form indicating that population declines at an increasing rate with decreasing rank.

The field data thus support Carter's (*loc. cit*) ideas. The stepped plot for the larger centres reflects their central place hierarchy. At each "step" the population falls off much more rapidly than the rank-size rule would have predicted, to be followed by a group of similar-sized centres. Functional and populational hierarchies both break down amongst the smaller centres.

Finally, it is instructive to plot population against Functional Index for the sample (Fig. 12). FI's have been lumped by parishes, as population data are not available below this level. The graph uses log scales so the thirteen parishes with an FI = 0 do not appear.

The figure clearly demonstrates a fundamental positive correlation between the two variables, a relationship closely linked to the concept of "threshold". Larger centres tend to cluster, corresponding in part to the purely functional classification (Table 2). The fourth-order centres show a particularly close grouping whilst the next cluster is a fusion of third and second order centres. The broad spread of points that follows confirms that the relationship between function and population is very tenuous as other factors impinge on the functional indices. Centres whose FI is low compared with their population are readily identified in Fig 12. Invariably these are settlements with substantial commuter or industrial development, e.g. Telford, Bridgnorth, Albrighton, Broseley, Pontesbury, Gobowen, Worfield, Bicton and Sutton upon Tern. Conversely, "true" central places, generally the long-established market towns and villages less touched by twentieth-century change, have high FIs for their population, e.g. Ellesmere, Bishops Castle, Montgomery and Bucknell.

The Movements of Shoppers

A sub-sample of six centres, comprising one fifth order (Shrewsbury), two fourth orders (Ludlow and Bridgnorth) and three third orders (Church Stretton, Craven Arms, and Much Wenlock), was chosen to investigate the relationship between functional status and the area from which customers are drawn. Respondents to the questionnaire were classified as "residents" (living in the centre where the interview

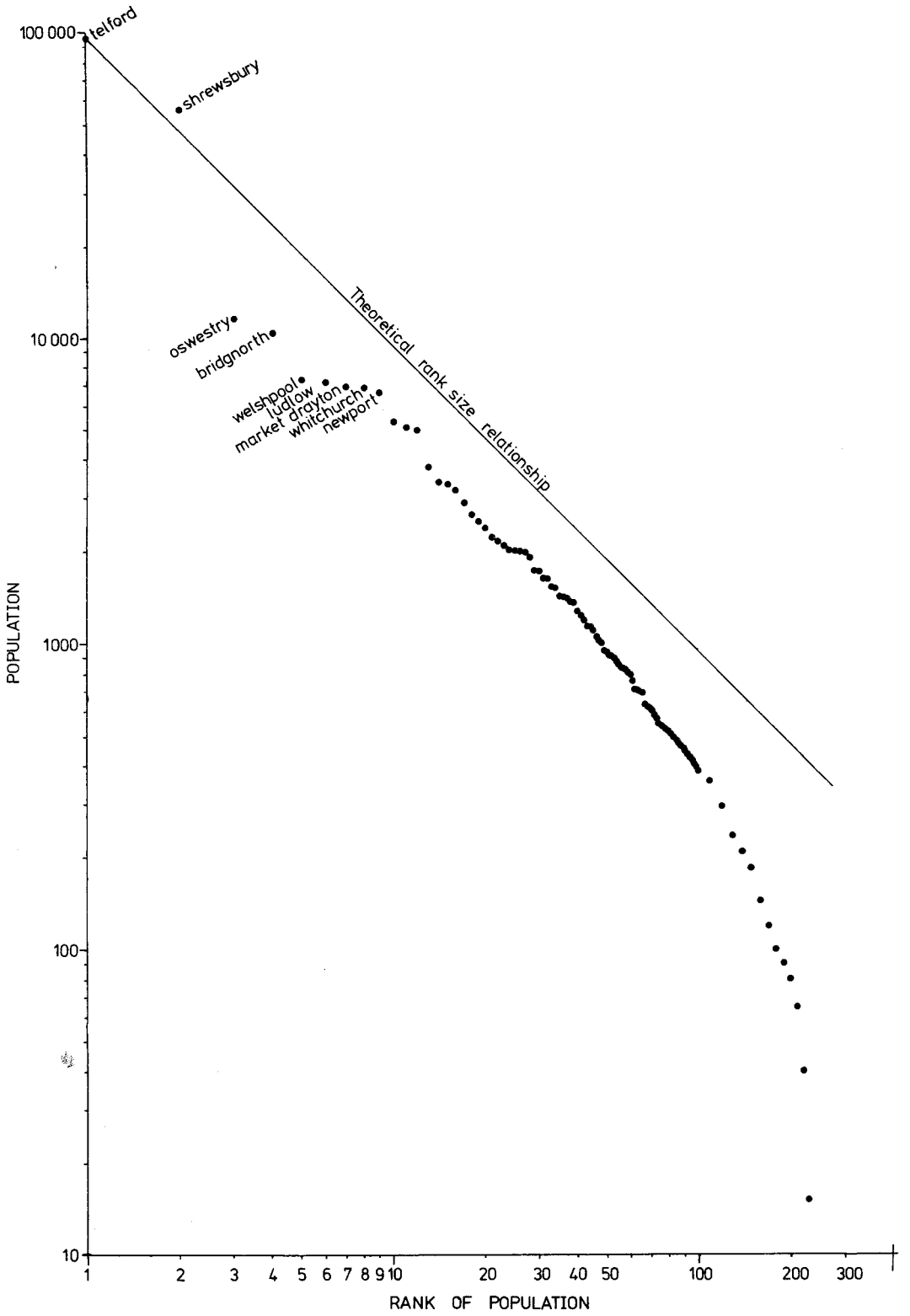

FIG. 11.

Population rank-size distribution

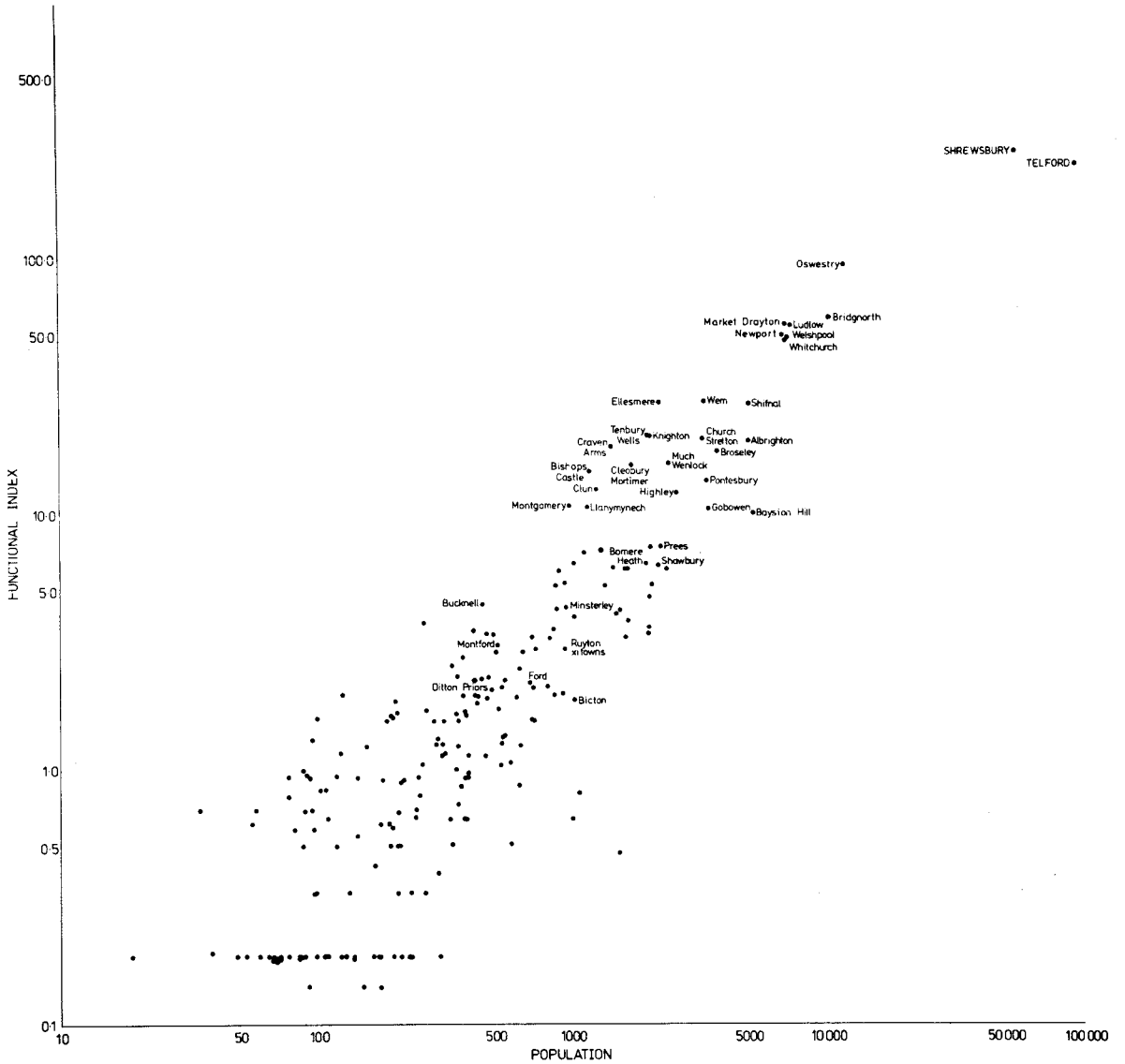

FIG. 12.

Population Functional index distribution.

was taken), non-resident "local" shoppers (visiting the centre primarily for shopping), and "visitors and tourists" (visiting the centre for some purpose other than shopping). The straight-line distance from home centre was plotted on a map for each non-resident local shopper. The distances were measured and grouped into 5 km classes (Fig. 13 and Table 5).

Apart from Ludlow, there is a definite relationship between a centre's FI and the distance local shoppers had travelled. The third order centres all show very similar patterns with a mean distance travelled of about 11 km. Additional factors, over and above central place importance, would appear to influence the distances travelled by consumers that visit Ludlow. Perhaps the added attractions of the town's historic

Table 5. *Results of consumer movement survey in six South Shropshire Centres*

Centres	Total no. of respondents		Residents	Frequency of non-resident respondents grouped by distance travelled													Visitors and Tourists	Mean distance travelled by non-resident local shoppers	Standard deviation
				5.0 km	5.1–10.0 km	10.1–15.0 km	15.1–20.0 km	20.1–25.0 km	25.1–30.0 km	30.1–35.0 km	35.1–40.0 km	40.1–45.0 km	45.1–50.0 km	50.1–55.0 km	55.1–60.0 km	>60.0 km			
Shrewsbury	698	no.	377	16	24	42	58	14	28	6	8	16	6	7	0	9	87	23.05	17.13
		%	54.0	2.3	3.4	6.0	8.3	2.0	4.0	0.9	1.1	2.3	0.9	1.0	0.0	1.3	12.5		
Ludlow	188	no.	67	4	10	13	10	7	3	4	6	7	7	2	3	0	45	25.9	15.75
		%	35.6	2.1	5.3	6.9	5.3	3.7	1.6	2.1	3.2	3.7	3.7	1.1	1.6	0	23.9		
Bridgnorth	617	no.	343	7	33	26	44	15	13	6	3	0	0	0	0	0	12.7	16.80	7.78
		%	55.6	1.1	5.3	4.2	7.1	2.4	2.1	1.0	0.5	0	0	0	0	0	20.5		
Much Wenlock	110	no.	62	9	13	9	3	1	2	2	0	0	0	0	0	0	9	11.57	8.20
		%	56.4	8.2	11.8	8.2	2.7	0.9	1.8	1.8	0	0	0	0	0	0	8.2		
Church Stretton	132	no.	63	5	15	5	3	1	4	0	0	0	0	0	0	0	36	11.17	8.22
		%	47.7	3.8	11.4	3.8	2.3	0.8	3.0	0	0	0	0	0	0	0	27.3		
Craven Arms	114	no.	54	10	10	14	3	0	4	0	0	0	0	0	0	0	19	11.04	7.48
		%	47.4	8.8	8.8	12.3	2.6	0	3.5	0	0	0	0	0	0	0	16.7		

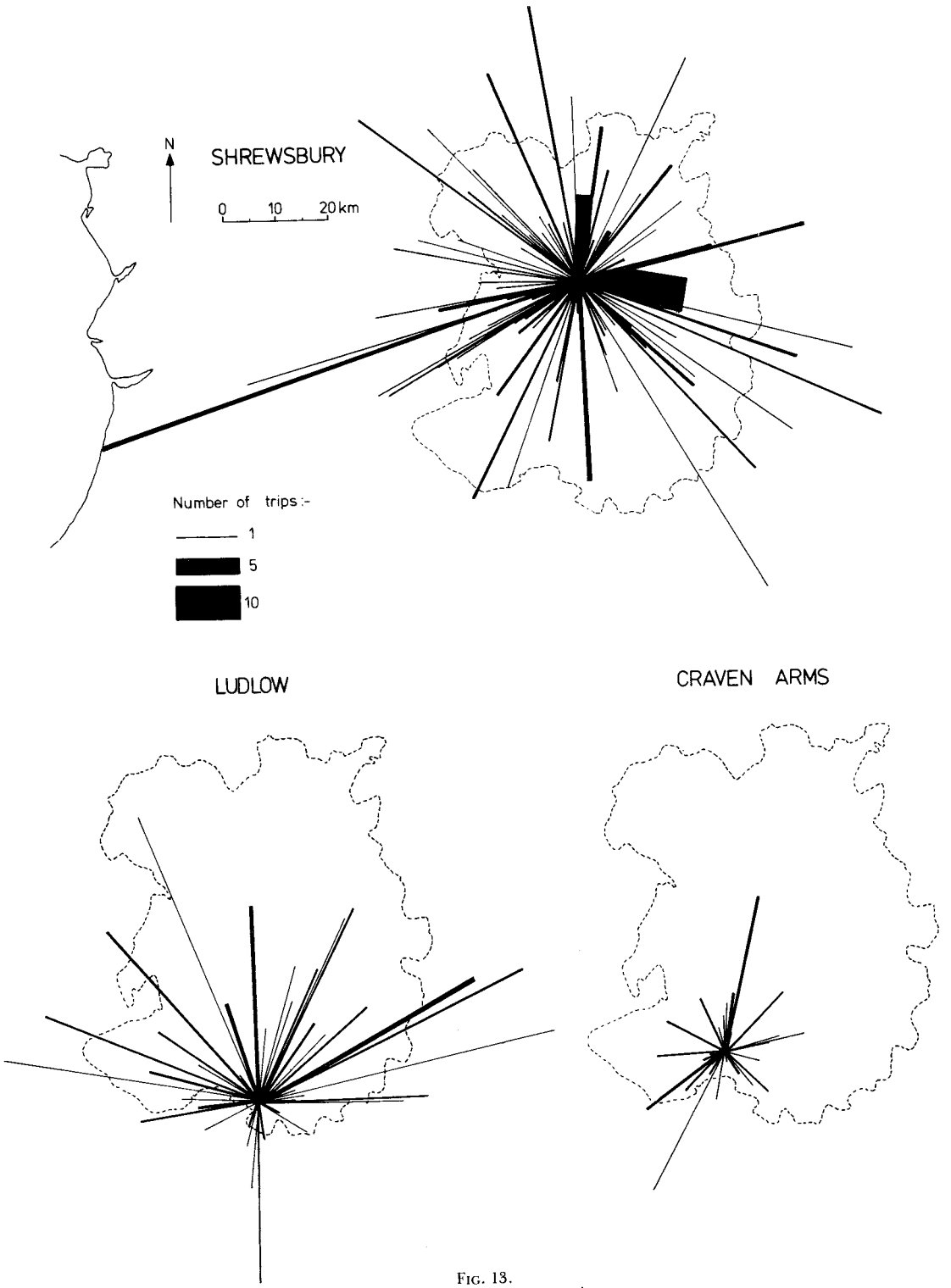

FIG. 13.
Saturday shopping trips to selected centres.

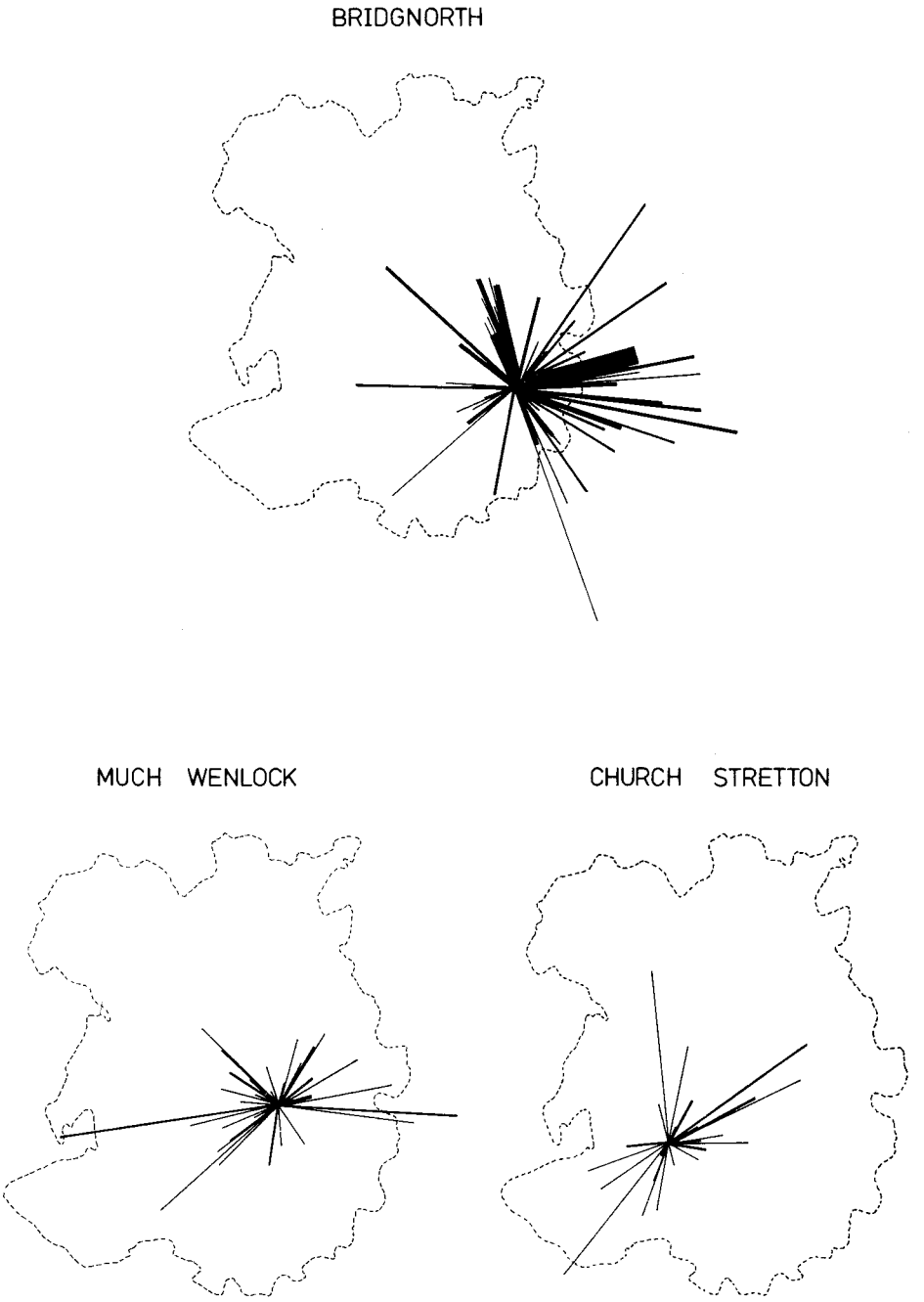

FIG. 13.
Saturday shopping trips to selected centres.

associations and architectural heritage allow the Saturday shopping trip to become something of a day out, fulfilling also a recreational or social role.

The plots of consumer movement provide further insight into the differences between human behaviour and the purely economic considerations of a model. Those movements to Shrewsbury which originated beyond the county boundary are particularly extended in a westerly direction with five respondents from as far afield as Aberystwyth. This reflects the absence of any central place of comparable size right across mid-Wales where the lower population densities fail to reach the thresholds required for large stores and specialised shops. A considerable trade is drawn from Telford, where, despite a high FI, the variety of high order provision is well below that of Shrewsbury.

Ludlow's plot is of interest in that few shoppers are drawn from Herefordshire. The county boundary appears to act as a barrier, with consumers from settlements to the south of Ludlow presumably showing allegiance to Leominster or Hereford despite the greater distance involved. Most of the plots, and especially that for Bridgnorth, show a notable movement of shoppers from the West Midlands conurbation. Despite their proximity to Wolverhampton and Birmingham City Centre these shoppers clearly prefer to visit a Shropshire market town. It may be that people consider a certain minimum size, and level of provision, essential for their needs, but, once these pragmatic requirements have been satisfied, they may assess alternative shopping centres on the basis of atmosphere, or change of surroundings rather than seeking more and bigger shops. The high proportion of visitors and tourists in the samples (especially in Church Stretton, Ludlow and Bridgnorth) indicates the importance of such trade to their economy.

To summarise: the results demonstrate a crude relationship between a centre's functional status and the size of its catchment area but the quality of the town's environment and its atmosphere are perhaps equally powerful attractive forces. But these conclusions, based on variable and sometimes small samples and an often arbitrary selection of respondents, must be regarded as provisional and tentative.

CONCLUSION

There need be no conflict between the historical or evolutionary approach to the study of settlement patterns and a theoretical geographical explanation. There were numerous deliberate attempts to establish new settlements in the Shropshire landscape, particularly in Norman and early medieval times. The subsequent growth, stabilisation or demise of these "plantation towns" (Rowley, 1972) frequently appears to be a function of Christallers ordering principle. Was there an unsatisfied demand for goods and services in that place to provide a role for a market town? Was it sufficiently accessible to the population of its hinterland? Or, conversely, was it too close to an existing competitor? Or, with changing transport technology, did it lose out in terms of accessibility? The supply of, and demand for, goods and services at any one time may be regarded as self-adjusting towards equilibrium.

With static demand, a well integrated system of central places would develop with an even spread of local centres fulfilling everyday low order needs, these in turn lying within range of larger centres providing less frequently required high order goods. A hierarchy of centres with precise functional relationships between its various levels and regular spatial characteristics would result. In the real landscape we find elements and suggestions of that idealised world, yet the perfect expression is always

elusive. This lack of complete correspondence between model and reality in no way negates the model: it simply emphasises weaknesses in the assumptions.

It must be acknowledged, however, that since Christaller sought "the causes of towns being large or small" economic, social and technological changes in both town and country have reduced the frictional effect which distance had traditionally exerted on consumer movement. In the centralised hierarchy demonstrated here, larger centres continue to grow in status whilst in many lower order centres (third and below) empty shop premises testify to the lost trade. Increased mobility of the population has extended the range of the dominant central places, enabling the high thresholds of specialised service provision and large scale retailing to be reached—thus further increasing their force of attraction. The economic advantages of centralised distribution and service provision are almost universally accepted, but there are also social and environmental disadvantages. Excessive centralisation operates against rural dwellers generally, and against the old, the very young and the less affluent in particular. To the less-mobile, increased distance to shops and services may mean denial of access. In the towns, centralisation may be accompanied by increased traffic congestion, polluted and noisy shopping streets, multi-storey car parks in conservation areas and higher energy consumption. There are considerable environmental costs to be weighed against those economies of scale that follow the concentration of central place activities into a few large centres.

A fully-integrated central place hierarchy, though at odds with many late twentieth century trends, remains both an egalitarian and efficient way of structuring a settlement pattern. No individual is then excessively remote from supply points for basic material and service provision. With varying degrees of local modification it is a structure which has evolved spontaneously in a variety of cultural and political settings—because of its efficiency.

As a basis for the investigation of rural settlement patterns the central place model provides a useful framework for the generation of hypotheses, the organisation of fieldwork and the analysis of data. The results, however, must be assessed in relation to the assumptions inherent in the model. It is likely that a hierarchical structure of service centres showing a degree of spatial regularity will be demonstrated. There will also be certain anomalies which may be investigated in terms of physical, cultural and historical factors; the role of industrial activity; and the far-reaching impacts of technological change on economic and social processes.

ACKNOWLEDGEMENTS

Much of the data was collected by Valerie Swann, whilst research assistant at Preston Montford Field Centre, as part of her Human Ecology course at Huddersfield Polytechnic. Thanks are also due to the many sixth-form geography students, and members of teachers' courses, at Preston Montford who contributed to the collection of data, and undertook questionnaire surveys.

We also acknowledge the assistance of Frances Rake in processing some of the data and of Adrian Bayley, Warden of Preston Montford Field Centre, for his encouragement and advice.

Roy Lewis, Senior Lecturer in Geography at the University College of Wales, Aberystwyth, and Charles Sinker both provided valuable criticism of a draft text.

REFERENCES

*BERRY, B. J. L. and GARRISON, W. L. (1958). The functional bases of the central place hierarchy. *Economic Geography,* **34,** 145-154.

BRACEY, H. E. (1953). Towns as rural services centres. *Transactions of the Institute of British Geographers,* **19,** 95-105.

CARTER, H. (1972). *The study of urban geography.* Arnold, London.

CHRISTALLER, W. (1966). *Central places in southern Germany.* trans. C. W. Baskin Prentice Hall, London.

*DAVIES, W. K. D. (1967). Centrality and the central place hierarchy. *Urban Studies,* **4,** 61-79.

EBDON, D. (1977). *Statistics in Geography.* Blackwell, Oxford.

EVERSON, J. A. and FITZGERALD, B. P. (1969). *Settlement patterns.* Longman, London.

LEWIS, R. (1977). *Central place analysis.* Open University D204 Section II Unit 10. The Open University Press, Milton Keynes.

ROWLEY, T. (1972). *The Shropshire landscape.* Hodder and Stoughton. London.

TIDSWELL, V. (1976). *Pattern and process in human geography. University Tutorial Press, London.*

WORSLEY, P. (1970). The Cheshire-Shropshire lowlands *in* LEWIS, C. A. (ed). *The glaciations of Wales and adjoining regions.* Longman, London.

* Reprinted in: BLUNDEN, J., HAGGETT, P., HAMNETT, C. and SARRE, P. (eds.) (1978). *Fundamentals of human geography; a reader.* Harper and Row, London.