The Nature of Geography within Pattern Analysis

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The ways in which geographers frame research questions vary enormously. Some differences reflect ideologies and philosophies, others represent various methodological preferences. Yet whatever the details of the approach, in almost every case it can be classified into one of two ways of asking the research question: are there relationships between phenomena in various locations, and are places different in terms of the phenomena present there? Geographers are concerned with places as the locations of man-environment inter-relationships. Delimiting a »place« is often difficult, but if such definition is feasible, it is then possible to characterize each place in a great number of ways (Johnston 1980).

A city for example can be identified by its area, the density of buildings in it, the percentage of its population, etc. The concept of the city is much more nebulous than it was in the historical past. The walls that guarded the medieval city defined the city so well because there was a compelling reason (security) for being inside the walls rather than outside them. Even in the nineteenth century the city was contained by a dominant central core and by the reliance on short-distance transport (foot, carriage, horse). Robson (1973) has argued that nineteenth-century cities are much better than modern cities for urban analysis (studies of the distribution of city sizes), because there are fewer doubts about what constitutes a city (Richardson 1979). Many definitions of an urban area emphasize the problem of determining the outer limits of the area. Defining a city in terms of spatially separate elements (»island in a sea«) increases the difficulties of administration. One possible definition of a city is in terms of the administrative boundaries of the political unit (the city government). The advantages are that many kinds of statistical data, especially fiscal data apply to the unit, and the administrative city has a unity to it derived from the fact that it is a policy and planning unit (an urban analog to the planning region. These minor advantages of politico-administrative boundaries are far outweighed by a critical disadvantage, that the economic and functional boundaries of urban areas spill over the narrower administrative boundaries. An interesting idea is the functional economic area that is based upon the concept of commuting fields, implicitly assuming that daily commuting flows are the most critical type of intra-metropolitan linkage.

A great encyclopedia of information can be gathered together for every »place« we can define. Therefore, at any spatial scale, a major function of geography has always been the collection and dissemination of »relevant« facts about places, but collection alone is not the basis for scholarly discipline. Facts are required for a purpose, which defines their »relevance«. In geography the purpose is understanding man-environment inter-relationship, hence our first question. To understand something implies knowledge of its origins and operations; to understand a city is not only to know how many people live there, their occupations and their life styles, but also why they are there, and how their existence in that place influences the lives of others, who live elsewhere. We cannot understand anything by focusing on it alone: we need general concepts, laws, and languages, otherwise we cannot even describe, let alone explain. The cause of a particular phenomenon can only be discovered in terms of general understanding about the operation of events. No phenomenon which geographers study is likely to result from a single cause. Understanding involves knowledge of causes, which require careful collection and use of evidence. To be valid, an explanation must be phrased in terms of known general statements concerning processes and forms. To explain the unique we must comprehend the general, and for the later we must study many places. Hence geographical research aims to explain that places are alike, and how their characteristics are created, what requires study of relevant phenomena over a wide range of places. Understanding unique phenomena involves setting them in their general context, therefore, and relating them to general processes (Johnston 1980).

The questions are places different in terms of the phenomena present there is perhaps the most basic to all geography. At the most fundamental level it could be considered a trivial question, for, since no two places can occupy the same place on the earth's surface, they must be different in the phenomenon of location. However, many argue that location is a relative and not a unique phenomenon, and in any case, location may not be a valid criterion on which to differentiate places; given that they are in different locations, do places vary in other ways? Do Slovenian cities have more people per hectare of residential land than Italian cities? The ultimate objective may be the description of a particular place, in terms of its unique characteristics, but this can be achieved from an understanding of what and where differences occur.

Some geographers are concerned with the personality of places, for example, with nuances of the characteristics of locations and inhabitants, the description, interpretation and explanation of which is only possible using linguistic methods. Different places can only be described as different in terms of recognized criteria which involves their mapping

over a range of places; particular patterns and processes can only be understood in terms of general concepts of inner-relationships between variables, applied to the particular context.

1. The study of map pattern

Geographers have used a number of techniques of analysis for the study of patterns. The map remains one of the geographer's predominant modes of communication. Map patterns are used in geography to represent phenomena at a variety of scales. For instance, points in two dimensions could use to represent individuals in a city park, or cities within the state. In many instances there is a belief that scale and process may be linked. This has prompted Harvey to suggest that we can turn this situation to our own benefit by using pattern analysis techniques (particularly quadrate analysis) to determine at what scale a process is operative. However, unfortunately, many of the existing probability models are geared to a particular scale of representation. This is especially apparent in models that are used to describe patterns of clusters of objects. It is very convenient to regard the world's population as distributed in a series of discrate and isolated clusters, we must recognize at the outset that this is a somewhat artificial concept. Our definition of a cluster depends largely upon how we draw our boundaries and how we define the term »isolated«. IGU defines an isolated unit of settlement as one that is at least 150 meters away from the next unit. Clearly we have to adopt some such artificial standard, but we must be prepared to modify this with larger settlements. The problem of the operational definition of »cities« is a complex one. Examination of the available information on large, city-size clusters suggests a remarkable regularity. The number of clusters is clearly directly proportional to size. There are relatively few large cities, many medium sized cities and a host of smaller cities. These models created merging assumptions describing the frequency of cluster sizes with other concerning the spatial location of the cluster. Since the models do not require assumptions concerning the location of individual objects within the clusters no statements can be made about this aspect of the pattern.

Geographers examine maps for two major reasons:
a) The descriptive approach involves identifying characteristics of the information conveyed by the map. This approach is employed for a number of reasons: chief among them is the need to summarize complex patterns;
b) the anaytical approach aims at identifying the processes considered responsible for the particular form of the phenomena. The emphasis is shift away from the morphology of the pattern towards a concern for the variety of physical, economic, social and political forces whose spatial expression gives rise to the patterns of phenomena. Consequently, in such circumstances the pattern becomes a mean to an end, rather than an end in itself.

Map patterns are examined in such diverse disciplines as archaeology, ecology, astronomy, metallurgy, etc. In many instances the approaches are similar to those employed by geographers. Archaeologists, for example have used patterns to widen the range of hypothesis that may be formulated to examine archaeological evidence which had not been previously understood (Hodder 1972, Hodder and Hassall 1971).

Through cartography, objects are displayed as symbols, usually of three basic geometric forms: points, lines and areas, in two dimensional plane. We can recognize two types of information covered by a map:

a) place data provide us with geometric information about the space (the density of points, the mean length of lines, the size distribution of areas etc.);

b) content data provide information about the objects (populations of settlements represented by points, traffic flows along roads represented by lines, the political affiliations of territories represented by different shaded areas, etc.).

Perhaps it is worth repeating that content data techniques take the location of the observed units as given and focus attention on the spatial variation of the variant values, while place data techniques focus on the geometric characteristics of the observation units themselves.

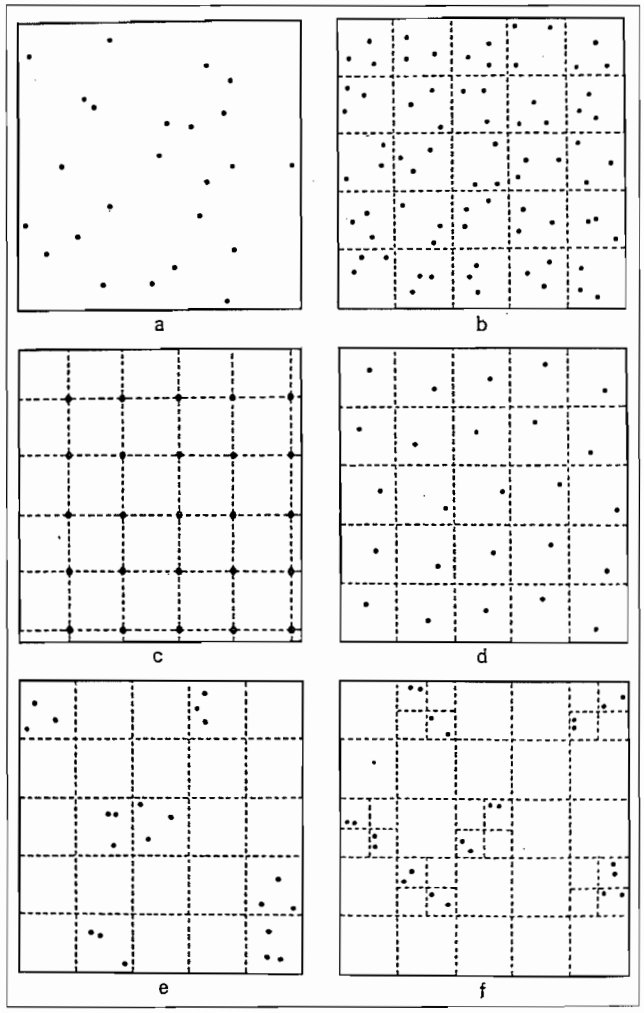
Among the various techniques used in pattern analysis the most common are:
- geostatistics (spatial statistics);
- quadrate analysis;
- nearest neighbour analysis;
- entropy;
- pattern indicators;
- graph theory;
- pattern recognition including classification, discrimination and regionalization;
- polynomial regression (trend surface analysis);
- harmonic regression;
- spatial autocorrelation;
- filter theory;
- spectral analysis.

Probabilistic spatial sampling, for example may be conducted using:
- points;
- lines (traverses);
- areas (quadrates).

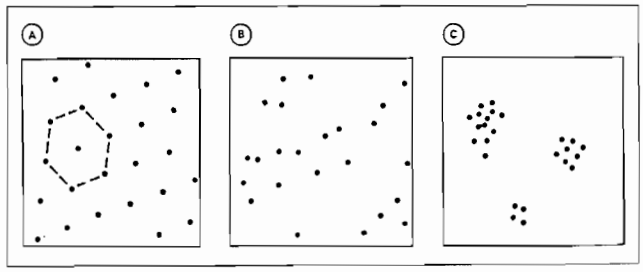
Within each form of spatial sampling, however, it is possible to devise numerous probabilistic designs. The problem then arises how to choose among these various potentials sampling designs. Berry and Baker (1968) point out that in the case of spatial sampling the »choice of sampling procedure for any phenomenon depends on how phenomenon is distributed. If the phenomenon being studied is randomly distributed then most sampling forms are appropriate and the choice therefore amounts to selecting that which is easiest. If there is a linear trend in the distribution, stratified sampling will be more efficient than systematic sampling, and systematic sampling in general more efficient than simple random sampling. If there is serial correlation (spatial auto-correlation) in the distribution of the phenomenon, then it is difficult to devise simple rules, for the »relative precision of the sampling procedures depends upon the shape of the serial-correlation function.« When this serial-correlation function is unknown, no optimal sampling design can be identified, so a stratified systematic unaligned sample would be suggested (Harvey 1979).

Suppose we are examining settlement patterns in a region and we feel that these might well have been established at random. In this case a simple pattern model, a spatial Poisson process probability model, might be appropriate. There is an assumption implicit in the Poisson model that is not representative of the empirical circumstances: the process is defined for a countable infinite number of objects in the Euclidean plane (Miles 1970). Obviously, the pattern describes a finite number of objects in a bounded area of finite size. Therefore, the model reduces to one that only approximates to these settlement process.

Medvedkov, for example, borrowing from the statistical theory of information, has applied the concept of entropy as a measure of uniformity and randomness in point patterns. He introduces the concept of entropy into settlement geography in 1966 as a new approach toward answering the question: are settlements spaced randomly, or is it possible to find an order in their distribution? Another technique utilizes the circular normal distribution to measure the directional component in point patterns.



Types of spatial point sampling design: a: simple random sampling; b: aerial stratified random sampling; c:. systematic random sampling; d: systematic unaligned sampling; e and f: two versions of nested random dampling. source: Harvey, 1979, p. 364.



Typical regular (A), random (B), and clustered (C) distributions. Source: Hagget, 1977, p.

Dacey (1962) has analyzed the distribution of hamlets, villages and cities in an area of the United States settled under the citieship and range system. Dacey used the technique of nearest neighbor analysis to compare the observed pattern with three expected distributions: hexagonal distribution, random (Poisson) distribution and clustered distribution.

An alternative approach to the evolution of settlement pattern is through the framework of Monte Carlo techniques. In this stochastic formulation, growth is simulated by random processes which are restricted by the operation of certain »rules« based on empirical observations of settlements behavior.

2. The spatial analysis

The spatial analysis comprising the study of three interrelated themes: spatial arrangements, space-time processes and spatial forecasting. By spatial arrangement is meant the location pattern of the objects under study - the configuration of, for instance, settlements, cities, roads, manufacturing plants etc. Traditionally, spatial analysts have classified these objects into point, line and aerial phenomena thereby lying stress on the geometric or morphological properties of those objects. Carried to an extreme, this meant that geographers were required to »pay attention to the spatial arrangement of phenomena in an area and not so much to the phenomena themselves«. (Barke 1986) The settlement pattern treats settlements as point-like objects and ignores their size characteristics. Such treatment represents only the »centroid« or center of gravity of continuous population movement. Morphometric analysis is a special form of cognitive description where systematization and classification develop from a geometric, spatial, coordinate system. This makes it feasible to undertake network analyses and to study the shape and pattern of the location of cities. Morphometric analysis can lead to certain types of predictive and simulation models. With a knowledge of the geometrical laws of central place theory, the population density and the size and location of two given central places, it is possible to predict the rest of a central place system. Geometrical predictions of this short have had increasing significance in geography. In morphometric analysis the stress is on measurement, whereas studies of landscape morphology usually take the form of cognitive description (Holt-Jensen 1981).

Spatial analysis is most closely identified with positivist explanation in geography, since it deals usually with formal models of spatial organization and assumes objective, certain knowledge of spatial arrangements and space-time processes. Largely as a reaction to this mode of explanation, humanistic perspectives have been forwarded, emphasizing instead less formal approaches to understanding the organization of human activity and the subjective, uncertain knowledge of such activity. In addition structuralist explanations urge us to abandon our concern with objective spatial structures as processes and to look instead at the »deeper structures« that underlie social activity and relationships. Both humanists and structuralists are dismissive of »geometrical configurations of human activity on the earth's surface. Humanists are dismissive because spatial analysis neglects man's »lived-world« of experience and the meaning of his environment to him. Further, if treats as »things«, the human beings who have unique experiences and relations to the world they inhabit. Structuralists are dismissive of spatial analysis because it describes only the apparent or »surface« structures rather than relations that are latent to society.

The questions geographers ask about location, about movement, about place, are ultimately about events in primate, physical space. Point pattern analysis, spatial autocorrelation, and spatial diffusion is couched in terms of simple Euclidean geometry. Geographical explanation may involve geometric properties of geographical distributions, but will not rely exclusively on these.

3. The distribution of settlements in terms of their size and spacing characteristics

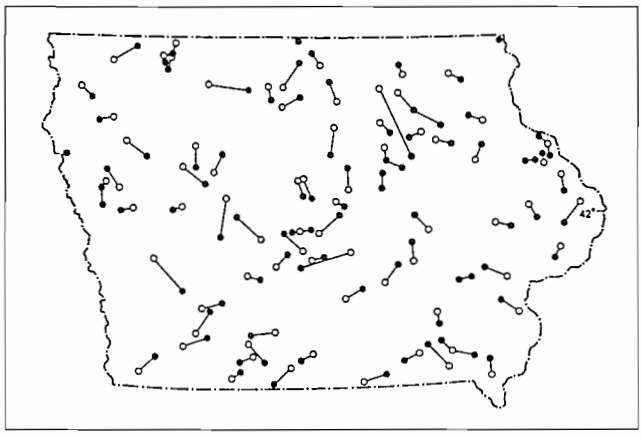
The tracing of the complex patterns of actual settlement processes is a problem in historical detection that demands a wide range of evidence. Chisholm (1962) has suggested that the diffusion of new smaller settlements around older and larger settlements may be linked to four major changes:
- socio-economic changes in the land holding system;
- removal of the need for defensive agglomeration;
- elimination of such factors as disease, which inhibited earlier land settlement;
- technical improvements in water supply.

Hudson (1969) has proposed a location theory for rural settlement assuming spatial processes similar to those found in plant ecology. The three components identified are:
- colonization, associated with the dispersal of settlement into new territory;
- spread, associated with increasing population density *in situ*

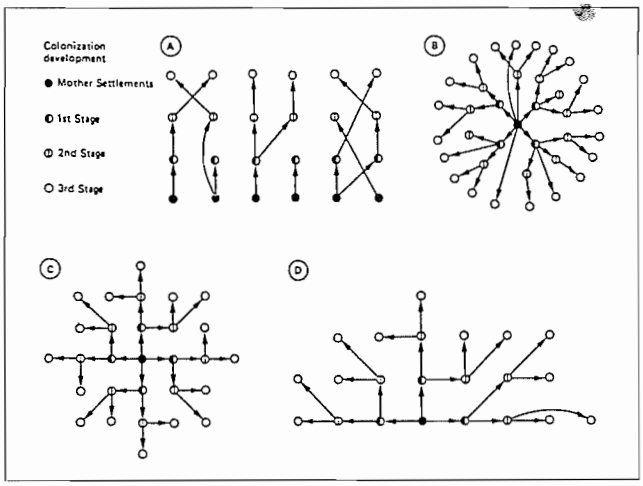
ing between settlements »of the same size« (Thomas 1961) showed a positive association between the logarithms of distance and population size. City size is associated with spacing, and this relationship holds in a hierarchical sense, since the sample cities are more closely associated with their larger neighbours.

In monocentric city space will be used most intensively close to the centre and the density of use will tend to decline in all directions with increasing distance.

Generalized cross-sections analysis of the distribution of population around cities suggests four general conclusions:



Nearest neighbours of sample settlements in Iowa. Source: Haggett, 1977, p.129



Hypothetical models of settlement diffusion. Source: Haggett, 1977, p.106

- urban population declines with the distance from the central city in a logarithmic fashion;
- density and rate of decline vary with the size of the central city;
- density and rate of decline vary with the regions;
- density and rate of decline vary with directions from the city.

This intensity of use at close-in locations reflects the high value (rent) of land due to the accessibility offered from these cities. The specific hypothesis is that intensity of use (as measured by gross population density) is a negative exponential function of radial distance:

$dr = doe\text{-}br$

where dr = density at distance r, r = distance from the city center, do = density at the city center, e = natural logarithmic base and b = density gradient. This may be transformed into the estimation equitation:

$log\ dr = log\ do - br$

so that b will be a downward-sloping straight line on a log-linear (density-distance) graph (Richardson 1979).

Spacing has been treated also in a wider context, as a function of the size of a city, its occupational structure, and the characteristics of the zone in which it was located (King 1961). It was argued that cities of a given size were likely to be more widely spaced where:

- rural population density is law;
- farming is extensive;
- agricultural production is law;
- where the overall population density is law;
- where the city itself has low proportion of workers in manufacturing.

It is implicit in the assumptions of a triangular lattice settlement, that the resources needed by each settlement are everywhere available - the assumption of an isotropic plane. If, however, we take a fairly simple settlement unit, the village, and its traditional requirements - agricultural land, water, building materials, fuel etc., - it is clear that in reality these resources are localized. Clearly the actual development of regional settlements' patterns is a multivariate product in which socio-economic conventions play as big a part as environment.

Inspections of settlements' patterns described by European geographers shows little immediate indication of a regular

lattice. Indeed attention has been focused on the shape of individual settlements rather than their general pattern. The description of patterns has not moved much beyond a simple dispersed-nucleated dichotomy. There are, of course, certain regular geometric forms that are clearly recognizable. The Roman centuriation pattern or arrangement of new villages on the reclaimed virgin land of the Dutch polders are small examples of regular lattices in Europe.

The basic theoretical concepts of central place theory are widely acknowledged among settlement geographers and have formed the basis for numerous empirical studies of relative location and spatial structure. Geographers have derived from this theory a number of hypotheses regarding the spacing and distribution of settlements of various sizes. Many geographers have attempted to test the validity of central-place theory by examining empirical evidence of actual city patterns. However, in many cases has been demonstrated that they do not conform to theoretical expectational spatial pattern. They developed several techniques for strengthening the power of explanation and prediction of settlement patterns.

4. Evolution of settlement systems

Historians, cultural anthropologists and sociologists would all offer different explanations of the reasons for cities, and many of them would be valid. Early location theorists considered transportation to be the primary factor in city location: cities were found at breaks in transportation. Cooley (1894) defined a »break« as an interruption of the movements at least sufficient to cause a transfer of goods and their temporary storage. A mechanical break involves only a physical interruption of movement and a commercial break includes a change in the ownership of the goods and so is of much greater importance. In his presentation of a theory of urban location Cooley noted the effects of military considerations, of religious prestige, of political forces and of the chance and possibly unwise selection of the first colonists. Besides these causes, cities owe their origin entirely to economic forces: division of labor. Two influences chiefly determine the location of cities: local facilities for production and location relative to transport (Černe 1984).

Perhaps the most extreme of the environmentalist studies of cities is Taylor's *Urban Geography* (1946). In his book he studies seven cities chosen for their latitudes and asks the questions:

- what induced man to settle in this region;
- why did he choose this particular site of all those available;
- what kind of settlement developed on the chosen site;
- how far has the settlement progressed towards the climax stage, having in view the period since it was founded;
- can we decide where the environmental factors and where the human factors have played the greater part in the present pattern.

The French »possibilists« stressed the human rather than the physical aspects of settlements' patterns. The continuing emphasis of the French scholars was on the interdependence of the city and its social and physical environment. This ecological view was carried into urban planning by Geddes. He emphasized the organic approach to city planning - the harmonious relationships between city and region, between city and environment, and land uses within the cities. Among later scholars who acknowledged their debts to Geddes were Unwin, Jefferson, Abercrombie, and Mumford (Černe 1984).

Hurd (1903) who provided the beginnings of a view that generated a new discipline urban land economics wrote on city locations and their determinants: »*The some factors create all modern cities: commerce and manufactures with political and social forces, being everywhere operative, the chief difference in influence coming from variations in their relative power.....*«.

Dorau and Hinman, the authors of *Urban Land Economics* (1928) reached the conclusions that the general location of a city would be determined by general economic, social and political factors, chiefly the economic, while the specific site would be determined by the local physiographic character of the area.

Economic historians have tended to explain the growth of cities in terms of accepted notions of industrialization and improved nodality (e.g., the coming of railways). An alternative approach to settlement evolution is to examine changes over time within the single city using economic base theory that is concerned with the relationships between the two sectors and their presumed significance for urban growth.

Scale economies are the second major explanation of cities. These may take several forms: economies of scale within a single plant accounting for the one-company city; economies of scale within an industry, a factor that explains why some industries are highly localized in a particular city or region; and external economies of scale for many diverse activities (agglomeration or urbanization economies), and

scale economies or some other productivity-raising force in agriculture. This has been very important historically.

Therefore cities have a common feature. They represent a spatial concentration of people and consequently of economic activity. There are many possible explanations of spatial concentration from the social need of man to live close to other members of the same breed and the desire for personal communication as a generator of new knowledge and ideas to the crowding together in medieval times for mutual defense. Nevertheless, the dominant reasons for cities are economic. This hypothetical world would consist of self-sufficient, evenly distributed households. These conditions would ensure the non-existence of cities. Differences in resource endowments between two countries imply that each country has a comparative advantage over the other in the production of certain commodities. In multi-regional system, the optimal sites are those with special advantages for interregional freight transportation such as river or coastal ports or land transportation nodes. This is sufficient to account for the development of many cities based on proximity to mineral resources, water, amenity resources (e. g. climate), proximity to fertile agricultural land etc. (Richardson 1979).

The economic aspects of urbanization have been actively studied and have yielded information concerning the rate and direction of economic expansion, economies of agglomeration for activities in cities, threshold conditions for successful entry of activities and the importance of technological change on the utilization of natural and human resources.

A general approach to the development of the spatial distribution of cities recognizes that urbanization involves more than the location of central place activities; much urban support derives from activities that do not depend on a local hinterland. Furthermore, the development of urbanization takes place through time, and conditions are constantly changing.

The distribution of settlements in any region (implying their location and size) is the result of a long and complex interplay of forces. Any study that proposes to explain the origins of such patterns must take into account these major factors:

- the economic and social conditions which permit and/or encourage concentrations of economic activities of cities;
- the spatial or geographical conditions which influence the spacing and size of cities;
- the fact that such development takes place gradually over time;
- recognition that there is an element of uncertainty or indeterminacy in all behavior.

The spatial analysis of distribution of cities comprises three aspects. Central place theory asks how large an area is necessary to support cities, what is an efficient spacing of settlements, if there is a hierarchy of settlements. Central place activities can be considered as those which serve a local market. The underlying assumption is that man makes some effort at organizing his activities over space in an efficient manner. Central place theory seeks to ascertain what is the most efficient division of space, given an array of functions. In contrast, industrial location theory treats spatial distribution of activities which serve regional or national markets and which depend on a complex of resources, transport connections, labor supplies etc. These are nevertheless of even greater importance than central place activities as support for urban populations. A realistic model of urbanization cannot ignore one or the other. An example of their mutual dependence is the emergence of an irregular central place net upon a mining industrial complex or an agricultural base.

The growth of cities based upon the location and concentration of activities implies also migration. Migration is the process in space through which the redistribution of population occurs.

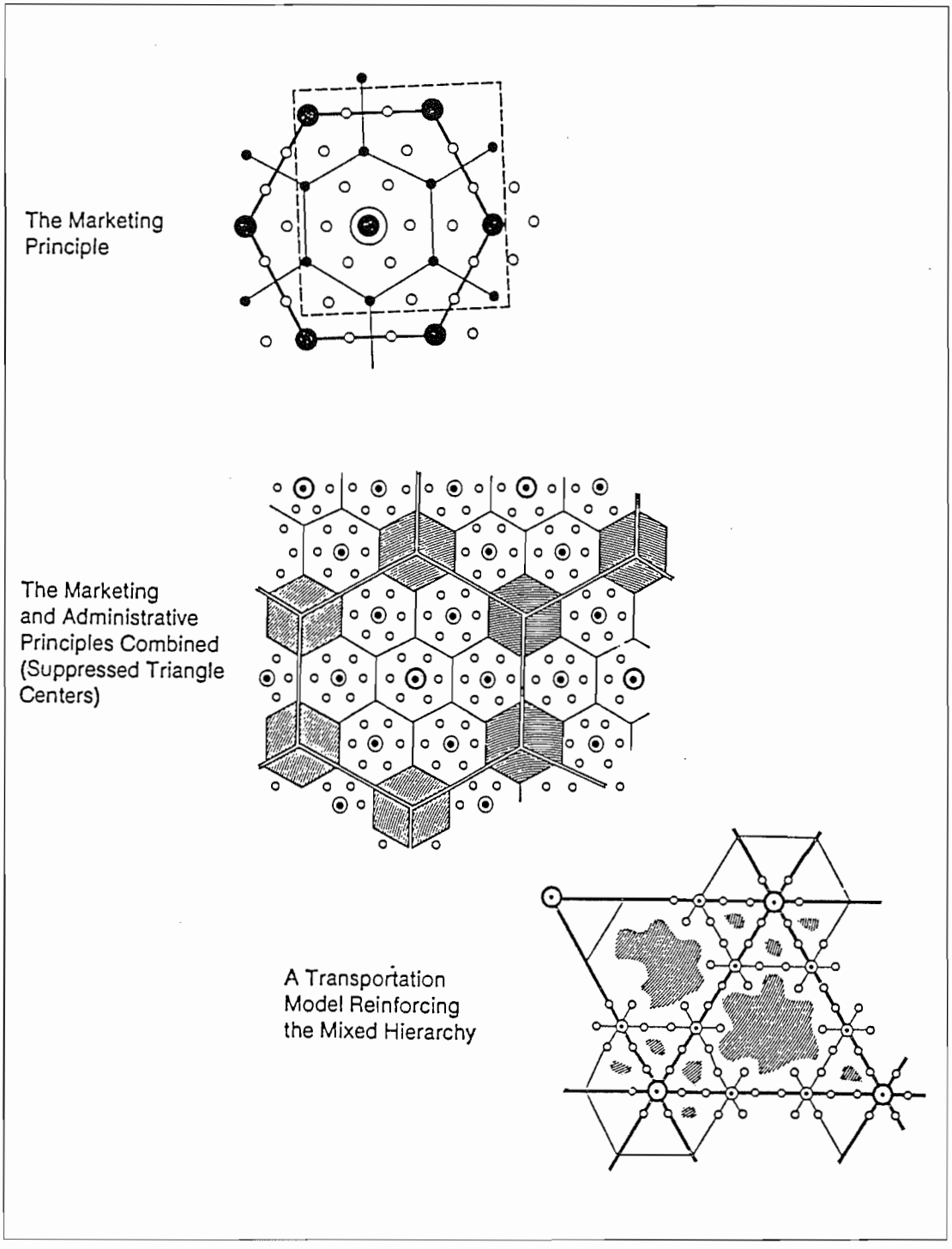
The spatial process of the development of rural land uses, especially in agricultural and forest locations, provides a close link between the natural environment and human settlement.

These spatial processes of central place location, industrial location, rural land use, and migration give rise to the observed distribution of settlement - a scatter of cities, a few larger ones, many smaller ones, and a transportation network linking the cities. Together they specify the spatial dimension of urbanization (Černe 1984).

The present settlement pattern is the result of a long interplay of forces. The historical dimension is of crucial importance to the study of urban development for three reasons:

- technological change;
- the characteristics of the urban population and physical plant are constantly being modified;
- locational decisions are made at a point in time, after which social and economic conditions may radically change.

Established locations possess great inertia: once decided



A mixed central place hierarchy. Source: Chistaller, 1941, p.8

upon, removal is difficult. An efficient decision at one time may be rendered obsolete well within the lifetime of the facility. Previous locations (later seen either as good or as bad) must powerfully influence future locations.

The urban system is still based on urban nodes, that is, on spatial concentrations of people and activities within the region or nation, but it also includes the relationships of the nodes to their surrounding areas and particularly the linkages among nodes.

The spatial organization has three main components:

- a set of attributes, or attribute matrix, which describes the structural characteristics (size, economic structure, social properties;
- behavior matrix, which indicates the patterns of interaction among the urban regions in terms of movements of people, data, goods, money, information;
- the interdependency matrix, which indicates how any city or location in the system responds to a change in any or all other cities.

Many different principles (or forces) combine to determine the spatial organization of an urban system. The military, the church, or the process of public administration each creates its own pattern of structure, flow and growth.

When the process of spatial organization (or urbanization) is examined over the long run, it becomes evident that the context provided by one organizing principle (e.g. the fur trade) inevitably affects the distribution of elements of those that follow, for example, the timber trade, and the railway. The effect is cummulative over a succession of organizing principles until what was initially an economic sector-specific spatial system becomes a complex, multi-purpose urban system, coordinating flows among many different economic sectors and effecting social relationships as well. As the range in size of urban regions increases and the limiting effects of distance and the local resources base decline, the urban system becomes more and more the dominant factor in the location and growth of any new economic or social activity - a principle of spatial organization in its own right.

Numerous commentators have described and discussed the development process of national urban systems. These researches drawn on different interpretive themes. These themes contain implicit models of system organization, such as size, spacing, interaction, and particularly the growth focus in the system.

The origins for one of the models lie in intuitive dissatisfaction with the landscape models of Christaller. Hilberseimer's (1955) maps suggested a linear system of urban places with strong connection links. This concept of such system, termed corridors, was developed as an empirical generalization.

The corridor hypothesis derives from three realistic postulates:

- the earth's surface is highly irregular as respect physical surface and land factors of production - principally soil fertility and the occurrence of minerals;
- changes in technology and other innovations affecting the character and intensity of man's use of the land do not occur simultaneously over very large areas, but spread from one or at best, a very few points of origin at greater or lesser speeds of dissemination;
- human achievement is the net effect of the totality of human decisions, both successful and mistaken, and on the whole, follows the principle of least effort.

Corridors show a very high preference for water. In the earliest phases of occupancy often the easiest method of transport was by natural waterway. Where a river was not navigable, and also when land transport later becomes more important, river valleys flank and terraces offered the easiest gradients, and the best such routes were followed by the earliest major roads and, later, by the first railways.

Subjective evidence that strong spatial correlation exists between urban systems and river systems can be found on almost any topographical map or atlas page. Most inland cities lie on a river of some sort, and large cities are often on larger-than-average rivers. The some idea of a basic city-river relationship can also be encountered in a wide variety of literature.

There are two very important characteristics that have relevance to any attempt at an explanation of city/river relationships:

- urbanization is inextricably enmeshed in the process of human territorial organization in its widest sense, not simply in the provision of market type services;
- most of the sites that are found today os cities had already been selected by the year 1400 or before.

Why initially urbanization found in riverine sites' advantages superior to those offered by almost all others, and why subsequently such sites continued to be able to accommodate urbanization successfully, despite the very marked changes

of the last 500 years. It is suggested that in the initial period many of the reasons are connected with the three major factors of stronghold, route and territory itself.

Defensive considerations were important in the local organization of a feudal society and to this end riverine sites, with the potentially double asset of natural moat and often steep river banks, possessed a decisine advantage. A combination of such a site and an established river crossing was even better - the ideal place from which to observe potentially hostile movements or obstruct them. Moreover, from their residential as well as their defensive role such stronghold-sites would attract other nodal functions - the need to render service to a lord, or attend his court to obtain justice - even before a servile population, largely preoccupied with subsistence agriculture, had any need or opportunity to participate markedly in trade and exchange. When, at a later date, such exchanges were formalized into markets these established »central places« were obvious choices for their location.

Unlike strongholds the relationship here is potentially more subtle, and does not necessarily lies in the obvious possibility that in some localities the use of water transport could transform river systems into route systems. Several commentators on urban development have stressed the importance of water transport in stimulating urban locations - »medieval man preferred to use water transport wherever possible«. The idea that river valleys may have generated early land routes is less obvious but not impossible.

The link suggested earlier between urban systems and territorial units, whether feudal or later administrative ones, prompts one further line of speculation. Might there ever been a crude relationship between territorial units and river-system units? Valleys are easily accepted as »natural« units in rugged terrain. But there are other aspects of territoriality which have potential relevance to any consideration of urban distribution. A city need not necessarily be located centrally within a feudal territory. If an European lord contemplating city creation could see that »if an important artery of road or water touched only at the edge of his estate there was no choice to all but to lay out the city at the point of tangency. When cities are formally related to discrate territorial units then the greater the number of units the greater the number of cities which they will require.
Riverine locations were often seen as offering several advantages:
- greater potential for water transport;
- more frequent coincidence with important land routes;
- more restricted crossings conveying enhanced nodality;
- even a more decisive potential role in defining units of »territorial thinking« (Dickinson 1984).

Aspects of association with a river as an important spatial common factor of the components of urban system does not, of course, define the pattern of that system. Other factors are at work here too, and identification of these, and the direction of their influence, was the concern of other urban studies, as we mentioned.

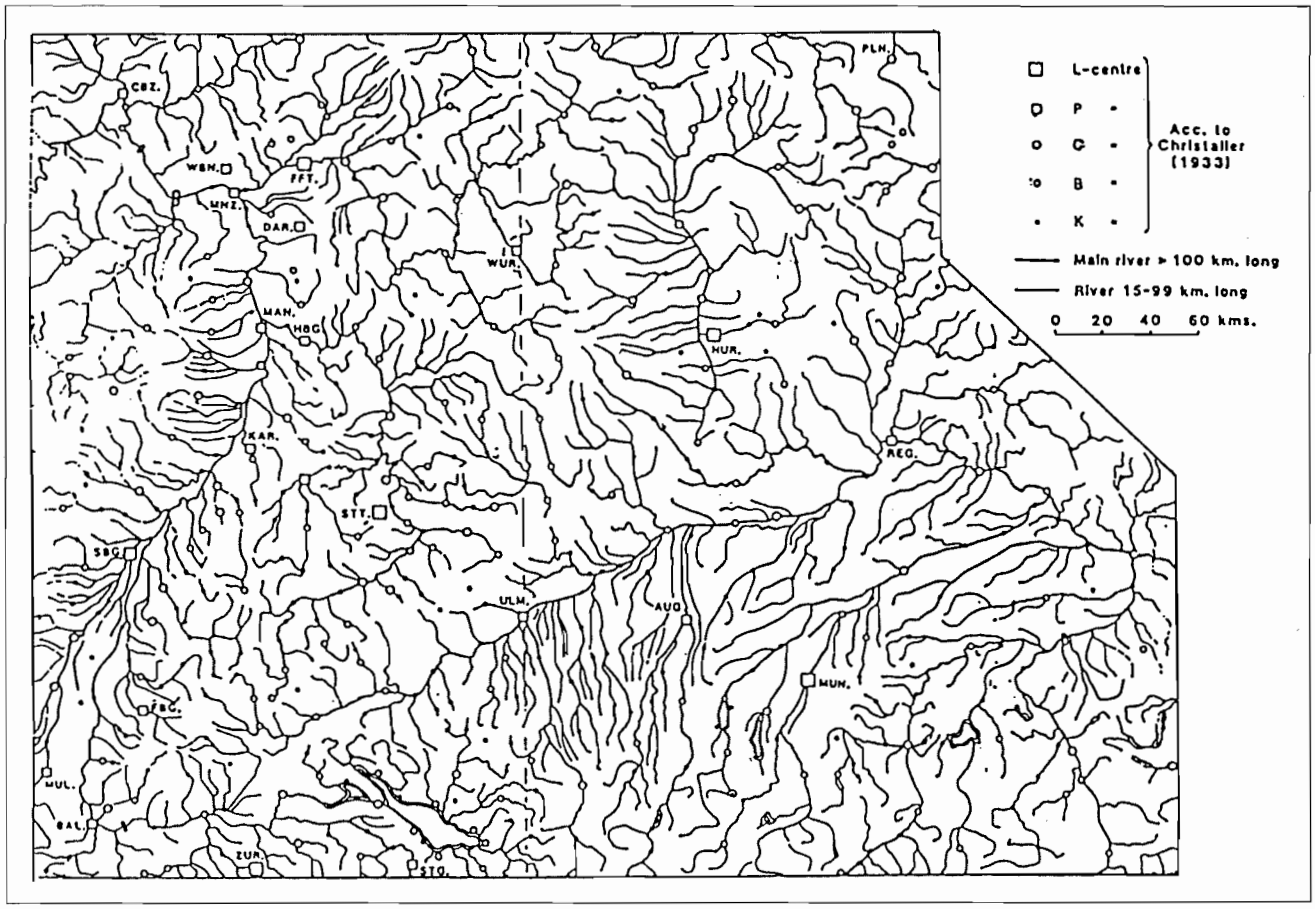
To illustrate the spatial development of a corridor system, Whebell (1966) prepared a series of five maps of hypothetical landscape:

The first period covers what has been called Initial Occupancy (Kniffen 1965). Those migrants moving into an area for the first time must make direct evaluations of the natural environment. Settlement locations is site-oriented; that is, for habitations and other structures there are sought out the most favorable spots or routes in the natural landscape.

It is difficult to define exactly the point at which a regional system passes from the Subsistence stage to that of Commercial Agriculture. A whole syndrome of changes appears to be involved. This period is make by the accumulation and employment of local capital in businesses and promotional schemes. Settlement schemes are organized to breach a »perceptual barrier«, that is, to break out of the river valleys or the areas of land thus far perceived as most desirable.

The accumulation of capital, entrepreneurial connections and ambitions, and the developments of sizable urban places with traffic potential, provide conditions for the building of railroads, which mark the beginning of the third stage. Transportation economies of rail movement, particularly the cheapness of coal for factories, motive power, than lead to establishment of industrial plants on the factory system; that is a special kind of diffusion, since the location of such factories is highly selective, and depends on availability of capital, enterpreneurship, and labor. Relatively small factories are built at first, becoming larger in the cities that prove satisfactory. In turn, the industrial activities of these cities attract non basic functions and yield still more capital for investment in communications and in more industries.

The traffic potential in the Automobile Era is of course greatest between major cities developing during the railway period. At the some time, roads are not so restricted to low gradient routes as were the railways. The economic momentum of well as their political influence, can be expected to



Components of the urban and river systems within southern Germany. source: Dickinson, 1984, p.36.

result in a road system that further reinforced their geographical situations and enhance their growth still further. The real urban expansion, with the creation of rural-urban fringe and dormitory »exurbs,« begins with this phase, spreading out the metropolitan places first along the easiest travel routes, i.e., along the corridors.

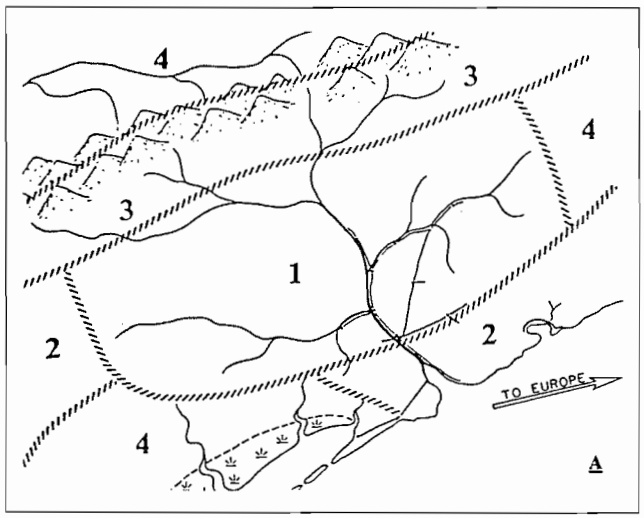
It is because these early zones of urban expansion become clogged, that the need then arises for high-speed, limited access motor ways to accommodate inter metropolitan traffic. The improvement in geographical situation accuser mainly, of course, to the metropolitan centers that are the chief origins and destinations of motor traffic, and only incidentally to other places adjacent to the route of the motor way; in this sense, the sorting out of urban places is analogous to that accomplished by the first railways. Whereas railways fostered the agglomeration of manufacturing and wholesaling into favoured urban places, the motor transport era has done the same for retailing and services, and continues to do so. The motorway effect is largely one of restricting still further the number of urban places suitable for continued agglomeration of these activities. Further reinforcement is afforded by location of airports close to the largest cities, an essential service for burgeoning »quaternary« industry.

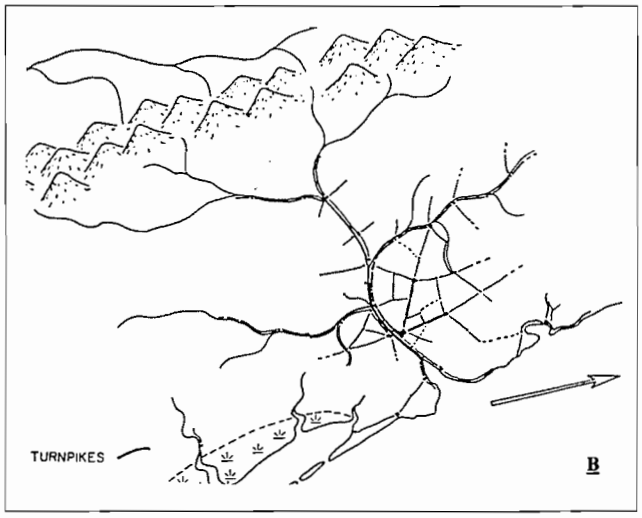
From the initial occupancy period's trial and error there emerges rudimentary lineation based on the perception of land quality and the development of urban places along the main routes of access to this desirable land. At first such nuclei act as staging points for the dispersal of migrants onto the land; later on, increasing surpluses of farm production move in the reverse direction, to the growing urban markets and export. As this happens, routes of least gradient (generally along river valleys) become the most utilized, and urban

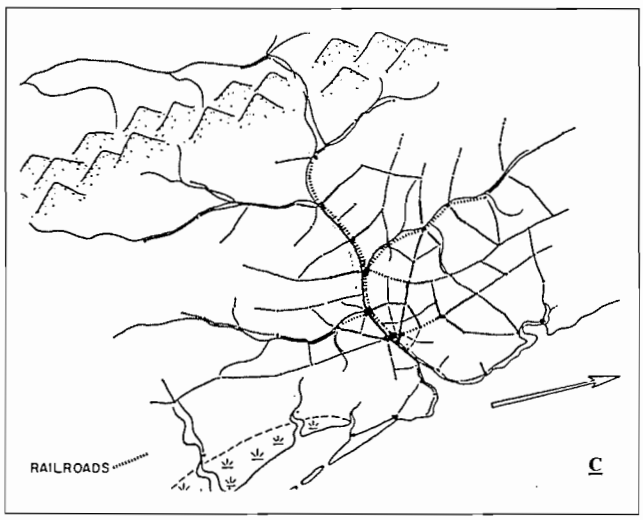
nuclei along such routes, and at junctions, enjoy enhanced business from their improved situations.

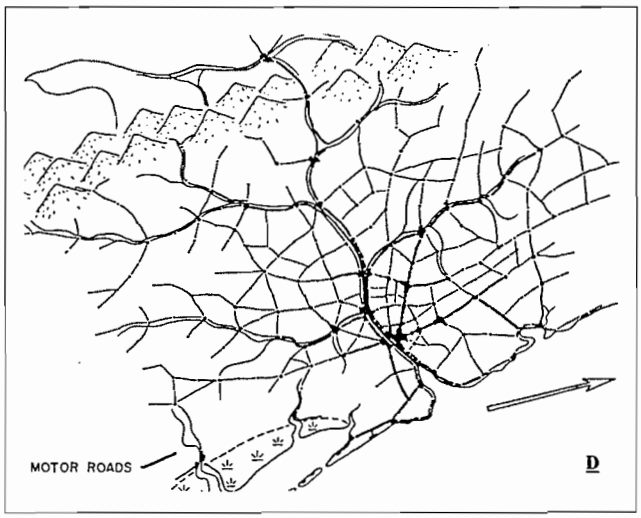
Increasing amount and intensity of land settlement, with resulting quantity of agricultural commodities, create the demand for better transport. This demand may be met by local capital employed in turnpiking the busiest roads and/or canalizing rivers that are not naturally navigable. Such improvements further enhance business in the cities along these routes, and especially in the senior city of the urban system, where quaternary activities begin to develop. Towards the margins of the settlement system, development is still at stage one.

Continued interest in lowering the cost of transport leads entrepreneurs, chiefly in the main cities, to promote and invest in railways. The most successful lines are those joining already well-developed cities, which provide the necessary traffic; in turn, the railways services aid in the location of manufacturing industries in such cities, so replacing the handicraft production, formerly disseminated over the rural landscape, by factories utilizing inanimate energy, particularly coal, which becomes widely available at an economic price. Industrial processes involving the bringing together of several raw materials are most apt to become established in cities already well served by rail and water facilities, and with a labor-supply available. Corridors now can be distinguished; the impetus provided by early railway connections to corridor cities gives them a lead that is difficult for later-founded places to offset. During this period, the growing number of leisured people in the cities, coupled with a dete-





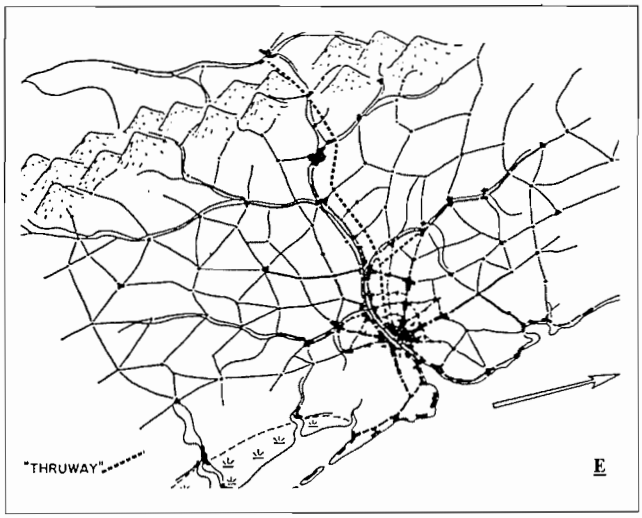




rioration in the quality of urban environment through industrialization and overcrowding, leads to the development of recreational centers for summering, chiefly along shorelines but also in mountains. The »aesthetic« level of landscape perception thus begins to assume major importance.

Unlike the previous period, in which roads served as the feeder system to the railways, the increasing use of the motor car results in a new emphasis on road transport. As first significant between major cities, the adoption of the motor car and its associated innovations (hard-surface road) leads to the stagnation if not disappearances of many low-order central places, as the economies of agglomeration and scale, effected previously by railways for manufacturing and wholesaling, now extend to retailing and service. Again, the improvement in roads and amenities for motor traffic occur earliest near and between important cities, and lead to an explosion in urbanism and sharp increase in recreational land uses.

The motor way manifests the dominant influence of metropolitan places in the entire landscape system, in the some way as turnpikes reinforced the situation of certain cities in an earlier age. Such high speed arteries exist essentially for the convenience of the inhabitants and businessmen of these senior urban places, the pre-emptive role of which is recognized by the political bodies who plan such routes. Rural dependency on urban places is now largely complete, and the problems of economic life become more and more polarized between the rural have-nots and metropolitan areas, where stresses occur from the very rapidity of growth. As urban centers coalesce, an alinear megalopolis begins to form.



The spatial development of corridor system. Source: Whebell, 1966, p. 135-142.

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