

LOCATION THEORY IN GEOGRAPHY AND ARCHAEOLOGY

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Locational analysis of the seventies is marked by expressions of disillusionment and criticism of the "quantitative revolution" of the sixties. "Especially so in the writing and work of some of those who were formerly quite active in the promotion of the spatial analysis theme and quantitative approaches" (King 1969:155). Despite the fact that those writing provide the main source of inspiration for archaeological locational analysis, critical geography of the seventies is utterly ignored in the archaeological literature. Thus, the aims of this paper are to present the geographical criticism of locational analysis and theory, to consider the archaeological implications and to suggest a possible synthesis of location theory in geography and archaeology.

"...Measures and counts now about in a field traditionally devoid of comparative scales: tax-onometrics... information indices of structural complexity, economic measures of utility, spatial measures of distribution ... The proper treatment of qualitative and quantitative observations has introduced a welcome precision and a proper appreciation of error, (and has) facilitated the testing of predictions... These reinforcing developments... give added scope to... explicit model-using... and the comprehensive theory of systems and cybernetics... Computer methodology provides an expanding armoury of analog and digital techniques... whilst all thinking archaeologists must share severe reservations about what has yet been achieved with the aid of these tools, the fault is with the uncertain archaeologist and his shaky concepts, not with the machine..." (Clarke, 1973).

"The second, more negative, point is the contending philosophies along with the whole 'systems' literature, have practically nothing to say about what sort of a city or a country we actually want or how to get it. Some authors thought they had only to formulate models which in a mathematical sense explain (i.e. represent) the process of urban development, without exploring its causes or evaluating its effects... When it comes to action, one man with clear and passionate vision can generally defeat — for better or worse — twenty operations researchers and all their systems" (Donnison, 1975).

The two quotations, brought together here due to the similarity of their titles, represent two prevalent views in their respective disciplines. In the first, David Clarke expresses enthusiastic belief in the potential of quantitative approach to produce a New Archaeology. The second, David Donnison's, is but one expression of the disillusionment and disappointment in geography with the "quantitative revolution."

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Spatial archaeology is a recent developing field whose main sources of inspiration are location theory and analysis. Among archaeologists this new field has received contrasting reactions — on the one hand of-hand rejection, on the other hand, unbalanced enthusiasm, as exemplified by Clarke's (1973) quotation above. Unbalanced since archeologists have taken notice only othe quantitative-statistical side of location analysis, but not of the criticism leveled at it in the last 15 years. The above quotation by Donnison (1975) is but one example of this. Such an uncritical application is understandable and, if compared to the early stages of quantitative geography, is probably typical in the emergence of a new scientific branch.

As a practitioner of locational analysis in geography and archaeology, I share Haggett's et al (1977) optimism that this new field will contribute to archaeology as well as to geography but only, on condition that spatial archaeology does not wait 15 years for the emergence of its own criticism, but takes advantage of the exiting criticism in geography and its consequent implication to archaeology. The main task of this paper is thus to present the criticism in geography and their implications for archaeology. However, before commencing with this task, let us first unfold the historical sequence from location theory to spatial archaeology and explicitly state the aims of this paper.

The studies of Thunen (1966) on agricultural land use, of Weber (1929) on industrial location, of Christaller (1966) on central places, and of Losch (1954) on general location theory, are generally regarded as the foundation of location theory. Until the end of the forties, the work of these "founding fathers" on location theory was only a side stream of economic-geography. But with the emergence of the quantitative revolution in geography in the early fifties, it was adopted as the main theory of human geography and planning. From that period on, location analysis has developed in two parallel streams. The first, theoretical, was basically an extension of the original studies of Thunen, Weber, Christaller and Losch. The second, and more dominant stream focused primarily on experiment and application. The main challenge was to investigate the quantitative-geometrical properties of the grand theories and to test theories against reality.

The efforts extended during the following decade to build a new, quantitative geography were first synthesized in Peter Haggett's *Locational Analysis in Human Geography* (1965). Gould described it as one of the first books available at that time which "one could put in the hands of a scholar in another discipline... without apologies" (Gould, 1979, 140- 1). *Locational Analysis in Human Geography together with MOdels in Geography* (Chorley and haggett, 1967) were not only important geographical syntheses but also marked the beginning of the New (quantitative) Archaeology. They were part of what harris has termed "the Cambridge connection": The fact that... "the conceptual winds of change that were beginning to blow through archaeology in Britain issued from Cambridge in 1968 in the bulky shape of David Clarke's *Analytical Archaeology*: (and) this was followed in 1972 by the still more massive *Models in Archaeology* edited by Clarke" (Harris, 1977, 114-5).

From the early seventies, while quantitative archaeologists began celebrating their victory, geographers were conversely beginning to strongly criticize "Quantitative Geography" which had provided a major source of inspiration to New Archaeology. Critical Geography, utterly ignored in the archaeological literatu+re on locational analysis, in the most prominent and important development during the last ten years in geography. The criticism has now been followed by attempts to find alternative theoretical passes; one of the more promising being, ironically enough, the application of methods, theories and data from anthropology and archaeology.

The aims of this paper are thus to present the geographical criticism of location theogry, to

consider the archaeological implications and to suggest a possible synthesis of location theory in geography and archaeology.

THE CRITICISM OF LOCATION THEORY

I suggest to see the seeds of the criticism of location theory, first in its peculiar structure of explanation, of which the following quotation from Losch is typical:

"Certainly, it is more than a mere coincidence that the theory of economic location has been almost entirely confined so far to the point of view of the individual firm. As in price theory, the interdependence of all economic events was eliminated by simplifying assumptions, and the problem thus made susceptible of geometric treatment. *But in contradiction to price theory, the proof of the existence of a general equilibrium and its conditions is of far less interest here.* After the Walrasian equations had confirmed the belief of the Enlightenment that even an economy given over to competition will hover in equilibrium, nothing fundamentally new seemed to have been added when this proof was complicated by the introduction of space and time." (Italics are mine) Losch, 1954, 92).

The importance of Lösch's statement is not only that it illustrates the dependence of his equations on the theory of economic equilibrium, but also that it demonstrates the peculiar nature of explanation in location theory. The analysis begins with the presumption that the theory of economic equilibrium represents the general forces governing reality, and it has no pretension of feeding back upon the economic theory; the aim is to derive an explanation for spatial order from general theories such as general equilibrium. Walras used price theory as a means of demonstrating a general theory of economic equilibrium. For Lösch and location theory in general, equilibrium theory, marginalist economic theory, and neo-classical economic theory as a whole are taken as a given truism — an accurate conceptualization of the real world. The theory about the general forces which govern society is never a subject for verification but only the derived spatial theory. The process of verification is not related to the general theory but only to the derived spatial theory. Consequently, contradictions between observed and theoretically derived events which result from the general theory cannot be detected.

The second problem concerns Thunen's construct — The Isolated State — usually defined by a set of three simplifying assumptions: the assumption of the Euclidian plane, the assumption of uniform densities (population, agricultural fertility, purchasing power, etc.), and the assumption of uniform transport facilities (Angel and Hyman, 1971). In order to empirically test the predictions of location theory one must find transformations which will permit the abstract space employed by the theories to represent real conditions. The efforts directed toward this goal (Tobler, 1963; Bunge, 1964, 1966; Warntz, 1967; Wardrop, 1969) were examined by Angel and Hyman who concluded:

"It is impossible to retain all three spatial assumptions... theories which require combinations of assumptions for which transformations do not exist such as the theories of Lösch and Christaller, cannot therefore be applied to realistic environments"...(Angel and Hyman, 1971, 32)

This criticism is all the more relevant in face of the common lack of correspondence between observed patterns and patterns derived by location theories. In such circumstances there is no way of determining whether and when this lack of correspondence results from employing the wrong simplifying assumptions or from employing the wrong general theory, or from both. Furthermore, since there was no feed-back between the general theory and the experimental stage, changes and developments in the general theory has little effect on location theory.

Location theory was also applied as a central theory for urban and regional planning (McLoughlin, 1969; Friedmann and Weaver, 1979).

In planning oriented research, location theory confronted reality not only through statistical data collected by the researcher, but also through its use to solve real socio-economic problems. It was here, in the realm of planning, that the contradictions in location theory were realized and they were abundant: 1) Most planning activities occurred under the aegis of public authorities. Yet location theory never considered the role of public authorities in planning. In fact, the theory ignores planning all together. 2) It was also realized that, while geographers were working within an idealized framework of a free private market with perfect competition, neo-classical economics, in order to cope with the increasing role of governments in the market, had developed Welfare Economics and Public Finance. 3) Planning involves constant confrontation with political problems of equality, income distribution and social justice in space. However, location theory of the quantitative geography turns a deaf ear to social and political problems, despite the fact that Thunen, Weber, Christaller and Lösch considered these problems. These charges were too significant to be dismissed by blaming (as was usual) the simplifying assumptions; obviously something more fundamental was to blame — the structure of explanation and the neo-classical economic theory which underlies the whole of location theory.

Geographers were not the first to look critically at the neo-classical economic model. The end of the sixties witnessed vigorous criticism from a wide spectrum including the Marxist Cambridge school (Robinson, 1970; Dobb, 1940, 1973; Sen 1970, 1973), the liberal view of Galbraith (1975) and a whole school of the "elite approach" (Parry, 1969), which was built upon the reaction of Pareto, Mosca and Michels to Marx's economic analysis (Buchanan, 1960). All of these fractions provided a ready made source for the emerging geographical criticism.

One of the first and undisputedly the most influential critic was David Harvey who wrote a series of articles subsequently published in his book *Social Justice and the City* (Harvey 1970, 1971, 1973). Harvey's articles mark the beginning of a decade of critical review in all branches of geography. In the following, I shall elaborate on five aspects of the criticism in geography which I believe to be of particular importance to the application of location theory to archaeology.

The Lack of an Institutional Framework

One main difference between classical political economy and neo-classical economics is the treatment of the political-institutional framework. The former starts with a set of postulates regarding human behaviour within a defined socio-political order: self-interest, profit-maximisers, individuals interacting in a perfectly competitive market with no government intervention. The Jevonian revolution, by substituting the classical distinction between 'use value' and 'exchange value' with the concept of 'utility maximization', could eliminate all ideological, social and political bounds. Thus, the same idealized world imposed upon the classical model as an exogenous moral constraint can now, with the neo-classical model, be regarded as an expression of pure economic laws (Dobb, 1973).

This new scheme was not without problems. First, while it was possible to eliminate the "political" from the "economy," this could not eliminate governments which continued to play a considerable role in the economy. Neoclassical economics responded to this by reintroducing governments through Public Finance and Welfare Economics.

In Welfare Economics, the rationale for government intervention is "public goods"; that is goods such as 'national defence' to which the regulatory mechanism of the market cannot be made to apply. Such goods which are demanded by society but cannot be produced and distributed through market institutions provide an economic rationale for the emergence of

governments. Samuelson's (1954, 1955) mathematical and diagrammatic exposition of "the pure theory of public expenditure" was followed by a spatial exposition of the theory of public goods with Tiebout's (1956) "pure theory of local expenditure". Tiebout laid the foundations for a spatial welfare economics and indeed, in the seventies, the academic criticism of locational analysis generated a revival of interest in the theory of local goods (Lea, 1979; Portugali, 1980).

While the conception of public vs. private goods within the neo-classical model does provide space for analyzing governmental activities, it does not eliminate the requirement for the imposition of an external ideological-institutional constraint. It has been demonstrated that the distinction between public and private goods is politically, historically, culturally and spatially bounded. Space, through its effect upon accessibility, is a major determinant of the degree of publicness/privateness of goods and services (Portugali 1976, 1980). What follows is that public activities can be analyzed within the neo-classical frame only statically in a specific location and time, avoiding the political-dynamic aspects by which different societies in time and space divide their economies into private and public.

The Lack of Historical and Cultural Perspective

The deliberate avoidance of any social context is, in fact, the main characteristic of neo-classical economic theory (Dobb, 1940). Different economies can be studied in isolation or even compared as independent entities, but the dynamic processes which connect different economies or lead from one economic state to the other are avoided (Dobb, 1973). Similarly the absence of a historical perspective typifies most of location theory:

"Thus, for instance, although both perfectly-competitive or monopolistic, or oligopolistic situations are studied, they are analyzed as separate situations, which might obtain perhaps in different places or in different sectors of the economy. The dynamic relationship between the two, and particularly the development of one from the conditions of the other are ignored" (Massey, 1973, 34).

This a-historical and a-cultural approach characterizes not only the neoclassical foundation of location theory, but also its philosophical framework of "positivism," as well as its other source of inspiration: the Chicago school of urban sociologists (Park, Burgess and McKenzie, 1925), with their 'concentric zone theory' of the city (Harvey 1973, 131).

The result was that land-use theory founded on a marginalist interpretation of Thunen on the one hand and the concentric zone on the other, was essentially static, only partially explanatory, and mainly applicable to north American cities (Alonso, 1964). In fact, by an explicit consideration of the dynamics of real income in relation to different socio-economic groups within the frame of the Alonso model it is possible to arrive at a more realistic solution for both Western and non-Western cities (Harvey, 1973; Portugali, 1976, 1980). This occurs when we remove the ban imposed by neo-classical economics on matters of equity and income redistribution.

The Effect of Space

One important shortcoming revealed during the critical review of location theory was that the entire static, a-cultural and a-historical basis of neo-classical economics became questionable when considered spatially. First of all, "there cannot be perfect competition over space... the whole set of assumptions about economic rationality and perfect knowledge become impossible to maintain over distance even ignoring as economic theory traditionally does, any institutional constraints" (Massey, 1973, 35-6).

Second, Lösch's theory demonstrates:

"...that a perfectly homogeneous landscape with identical customers working inside the framework of perfect competition, would necessarily develop from its inner rules of change, into a heterogeneous landscape with both rich, active sectors and poor, depressed regions. The homogeneous regional system negates itself and generates dialectically its contradiction, as regional inequalities appear. Until Lösch, geographers explained such heterogeneity by physical factors... or external human factors... Lösch has shown that, even if such disparities did not exist... the inner dialectical logic of the system would turn it, from the inside, into its very contrary" (Marchand, 1978, 129).

Third, another overlooked property of central place theory concerns the demonstration that the "spatial demand cone", (the initial contract for deriving the system of central places), is, at the same time, a "real income distribution cone" (Portugali, 1976, 1980). This is particularly apparent within the isotropic plane (though not restricted to it) where the introduction of a service anywhere on the plane immediately offsets the initial uniform distribution of real purchasing power. In real terms and within a dynamic setting this implies redistribution of real income. Since on the isotropic plane proximity to the central place is the sole factor which determines real income and since consumers can move freely over the plane, they will try to relocate themselves as close as possible to the central place. The result will be redistribution of population densities in such a way that density will increase with proximity to the center. When we proceed to derive from the above spatial demand/real income cone a system of central places, the result will be polarization of firms, income and population in a few high density urban centers, leaving wide areas unserved, or at most, poorly served. In this landscape rich and poor sectors are truly derivative and not an external imposition.

The spatial demand cone thus conceived resembles the concept of public good which, according to the neo-classical economic criteria, requires political "non-market" intervention. In more general terms, since spatial inequalities are an inherent quality of space and since every economically efficient locational pattern is conditioned by income redistribution, a mechanism external to the economy is required to determine which, and under what conditions, one sector should become rich and another poor.

The consequence of critically examining the assumptions of neo-classical economics within a spatial context never emerged in location theory because of the peculiar structure of explanation described above: namely, that the general theory that provided the basic foundation for location theory was accepted as a given constant. As Lösch put it: "...nothing fundamentally new seemed to have been added when this proof was complicated by the introduction of space and time".

Misrepresentation of the Classical Location Theories

The critical analysis of the foundation of location theory commenced with the classical location theories, assuming that the contradictions and shortcomings of location theory are rooted in the works of Thunen, Weber, Christaller and Lösch. (For example, Harvey, 1973; Barnbrock, 1974; Massey, 1973). I suggest that a closer examination reveals a discrepancy between the founding theories and their interpretation by quantitative geographers. In particular, Thunen, Weber, Christaller and Lösch were fully aware of the limitations and problems associated with their theories, and they explicitly state them. Hence, the criticism cited above applies mainly to the new generation of quantitative geographers, who have taken and used the original theories out of their original contexts. Thus, despite the fact that it is possible to show that Thunen's theory "contained an unequivocal legitimation of marginalism" (Gregory, 1978, 39, after Barnbrock, 1974), Barnbrock quoted Thunen to show that: "... the real focus of von Thunen's work is summarized in the question: is the meager wage that the common labourer gets almost everywhere a natural one or is it caused by exploitation which the labourer can't avoid?" (Barnbrock, 1974, 59).

Similarly, although Massey (1973, 35) correctly claims that Isard (1956) and Moses (1958) "have shown how Weberian concepts can be incorporated within the existing marginalist substitution analysis", Weber himself cannot be called a "marginalist". Weber, who was strongly influenced by his elder brother Max (Gregory, 1979), made a clear distinction at the outset of his work between "pure theory" and "realistic theory": pure theory: "... starts from certain simple premises ... to deduce therefrom the entire system (Mechanik) of "pure" rules of location" (Weber, 1929, 11). Realistic theory on the other hand: "... results... from very definite central aspects of modern capitalism and is a function of modern capitalism which might disappear with it" (Weber, 1929, 13). Later, this was followed by an essay attempting to sketch out a theory of capitalistic (realistic) location which has never been translated into English (Gregory, 1978).

Lösch, who more than the others, derived his theory from the formalism of economic equilibrium, clarified several points. First, that his theory of the best location is totally normative (Lösch, 1954, 4). Second, that it is purely economic and: "... might be acceptable, at best, as a very rough first approximation. A more precise analysis, insofar as economic considerations play any role at all, cannot disregard the interdependence of locations... The competition among possible locations is worse than imperfect". Third, that economic laws are essentially moral laws: "The natural equilibrium of economics differs from equilibrium of nature exactly as the moral differ from the mechanical. Nature works according to laws, but man acts according to his idea of laws... nature must, man may, act correctly" (Lösch, 1954). Fourth, in reality spatial equilibrium is socially and politically conditioned, and: "... must first be validated, or at least respected, by the legal framework or by economic policy". But, despite Lösch's recommendation that: "the conditions that they express, rather than the equations themselves, are of great importance" too often only his equations and their diagrammatical representations are cited.

Beavon (1977, 80) notes: "It appears that the stylized representation of Lösch's city-rich and city-poor landscape... as represented by Haggett (1965) has been instrumental in encouraging the belief that the pattern of central places in the Löschian system appears to be in closer accord with reality than that of Christaller". But, this would pertain only to the mechanic-static section of Christaller theory, on which Christaller himself writes:

"It should be borne in mind and emphasized again and again in order to avoid misunderstanding, that we have only a scheme... the most favorable state... not in the sense of valuation, but in the sense of the highest rationality with the least loss of value. Yet the real values which are most rational, change consistently as a consequence of the change in population, customs of life, technology, etc." (Christaller, 1966, 70).

From the start, Christaller makes his static "pure" theory historically conditioned. In fact, he has divided his theory into three parts. In Part A, he considered "fundamental meanings". In Part B, which he called "static relations", he derived his systems of central places according to the marketing, traffic and the "political-social" principles. In Part C, termed "dynamic processes", Christaller explicitly analyzed changes over time and space of population, income distribution, price variations, changes in the level of centrality of goods, changes in the range of goods, the concept of subjective distance, the effect of historical sites, and so forth. The above historical, normative and political contexts within which the classical location theories were formulated, were never mentioned by the second generation of locational analysts. The latter have simply selected two basic elements out of the whole context of classical location theory: first, that portion of the theory which could be formulated within the frame of neo-classical economics, and second, the part which could be quantified.

The Criticism of Quantification

The main stream of quantitative geography, concerned primarily with probabilistic-statistical explanation, never touched the general economic theories nor, in most cases, the spatial theories. Theories were accepted as given, or else they were treated instrumentally. The aim was to find the "best fit" for the data and then look for the relevant theory to explain it (Gregory, 1978). The relevant theory, that is the explanatory device, could have been a socio-economic location theory or one that was borrowed from the natural sciences. Twenty years of quantitative geography produces a very high standard of quantitative research (King, 1979). The problem lies, however, in: "... a clear disparity between the sophisticated theoretical and methodological framework we are using and our ability to say anything really meaningful about events as they unfold around us" (Harvey, 1973, 128). Each disparity between the model and reality was usually interpreted as a shortcoming of the measuring tools. Consequently, the reply was to sharpen the mathematical precision of the analytical tools. But as King pointed out, beyond a certain point: "... theoretical work begins to feed upon itself and not upon further observations of the real world" (King, 1976, 302). Leslie King, an authority in quantitative geography, is not arguing against quantitative analysis in toto, but criticizes certain specific aspects. First: that by over emphasizing quantification: "... theory development may degenerate simply into a form of 'recreational mathematics'". Second, that: "... the insights afforded by our studies of the spacing of cities and urban population densities and the like, when stripped of their veneers of statistical manipulation, often have seemed pale in comparison with the scholarly contributions of many of the historical and cultural geographers" (King, 1979, 156). One consequence of commitment to quantitative explanation is the phenomenon we have noted above: a selective reading and interpretation of the classical location theories. This approach still has much power as can be seen from a recently published book on "Christaller central place structure" (Alao et al, 1977). At the outset of their work, the authors note that they will deal only with the quantifiable elements in Christaller's theory. It is of interest to compare this note with Christaller's own opinion on such an attempt:

"It seems unnecessary to express in mathematical formulas the results discussed in the previous paragraph. The possibility of a mathematical expression is self-evident and is easily realized. But in economics, in anthropogeography, and in all the disciplines combined, only a few factors can be given precise values; and since most of these factors are unmeasurable intensities of desire, action, valuation and comparison, which can be put into mathematical terms only quite roughly by estimation and comparison, the mathematical expression of a relationship *a priori* cannot be exact. The formula could be highly symbolic — but then the reader would be inclined, as a rule, to take it as absolute and as allowing no exception, and finally, the author himself might mistake the numerical symbol which ought to serve as an expression of the valid laws, as a genuine mathematical formula" (Christaller, 1966, 70).

LOCATION THEORY IN ARCHAEOLOGY

Many archaeologists, myself included, would judge that most attempts so far to apply locational analysis to archaeology have met with little success. The reason is, in part, the nature of archaeological data which must contend with problems of site-survival, contemporaneity of settlements, size and intensity of settlements, measures of spatial interaction, correlation between historical evidence and archaeological remains, and so forth (Hodder and Orton, 1976; Johnson, 1977; Hodder, 1978; Portugali, 1982). Without underestimating the above difficulties I suggest that part of the 'limited success' may be attributable to the misuses of location theory presented above.

Reliance on Secondary Sources

A central characteristic of locational analysis in archaeology is the reliance on a particular set of secondary sources, namely, the geographical-experimental tradition of quantitative geography. Rarely have the original theories or their refinement over the last 30 years, received attention. Peter Haggett's *Locational Analysis in Human Geography* (1965), is probably the most quoted source. However, Haggett wrote *about* location theory and not the theory itself. Every secondary source may misinform the reader and cause subsequent misinterpretations. The most prominent one is the one recently noted by Beavon that: "Several general texts... have given the impression that Christaller explicitly assumed an isotropic surface. Nowhere did Christaller specify an isotropic surface" (Beavon, 1977, 19). Muller and Diaz (1973) have also drawn attention to a similar misrepresentation of Thunen's theory. Locational analysis in archaeology is already an interpretation of interpretation and the chances for cumulative mistakes are consequently intensified. One of the criticisms of central place theory often mentioned in the archaeological literature is that it is restricted to retail production and marketing (Adams, 1974; Smith, 1976; Johnson, 1977). This is partially true of Christaller's theory which focused more on the 'marketing principle' and less on the 'transport' and the 'socio-political' principles. This, however, is not at all the case with Lösch's. His central place theory is more general and includes industries, agriculture and retail marketing. Consequently, Lösch's theory is more complex than Christaller's (Hurst, 1972), which is one reason for "the lack of attention given to Lösch's work and the relatively low level of interpretation thereof" (Beavon, 1977, 80).

No Theoretical Basis

Every secondary source is subjective in the importance it assigns to location theory within the overall framework of locational analysis. Haggett, for example, tends to emphasize models, statistics, mathematics, geometry, etc., rather than location theories. This was a legitimate approach since both the theoretical and statistico-quantitative approaches were represented in the literature. Archaeologists applied only the Haggettian empirically oriented stream but, unlike geographers, they could not rely on the theoretical extensions of Isard (1956), Mills (1972), etc., since the latter were directly related to modern western society. This resulted in the formation of quasi-experiments which were devoid of any sound theoretical foundation, and perpetuated a general confusion about what location theory actually is. Archaeologists who often confuse location theories with their geometric appearance and the techniques developed to test it obscure the borders between observations, theoretical explanation and experimentation and, above all, assign paramount importance to quantitative-statistical tools within the overall frame of locational analysis.

Selective Reading

A secondary source is subjective in its commitment to a specific mode of scientific explanation. In geography this entailed a selective reading and misrepresentation of the original location theories. As noted above, fundamental sections of the original theories of Thunen, Weber, Christaller and Lösch were ignored in the last 30 years. The adherence of quantitative geography to a single mode of explanation was wholly adopted by archaeologists. This further restricted their exposure to geographical literature on locational analysis; for they, after having received an already abbreviated presentation, became even more selective in their own reading and adoption of locational analysis. Thus, while every new quantitative innovation in geography is being immediately applied to archaeology, not a single mention is made about the fact that quantitative methodology in general has been critically scrutinized and re-evaluated over the past ten years; absolute silence prevails despite the fact that the critical

analysis of locational analysis in geography has been acclaimed the most important development of the seventies (see *Annals of the Association of American Geographers* 69, 1, on "seventy-five years of American geography"). Moreover, the criticism is made not by new, anti-quantitative researchers but by some of the "veteran" quantitative geographers (Blaut, 1979, 16), whose studies were the main source of inspiration for archaeologists. Thus, in archaeology, Harvey's (1969) *Explanation in Geography* is fully quoted, but no reference is made to the Harvey of the Seventies (1970, 1971, 1973), when he made probably his most important contribution to geography. Leslie King's *Statistical Analysis in Geography* (1969) is intensively used in archaeological studies, but not his "alternatives to a positive economic geography" (1976), nor his "the Seventies: Disillusionment and Consolidation" (1979). Gunnar Olsson's "*Distance and Human Interaction*", (1965) yes; his "*Birds in Eggs*" (1975), or "On the Mythology of the Negative Exponential..." (1978), no. (See also Olsson 1971, 1972, 1974). And this is just part of the list.

Ad hoc Commitment to Quantitative Explanation

Thus, the application of locational analysis to archaeology was in essence the application of quantitative statistical methods. Nearest neighbour analysis, the rank size rule, gravity/interaction models, together with spatial versions of conventional statistical tests, such as trend surface analysis, were all successfully applied to archaeology (Hodder and Orton 1976, Hodder, 1978b). Indeed, the advantages of statistical analysis are enormous as long as statistics remain a tool for explanation. But ad hoc commitment to statistical explanation can become a constraint. Consider, for example Hodder and Orton's comparison between the "traditional", "unsatisfactory", "subjective", "uncritical", "eye ball", methods of map interpretation and the "statistical definition of spatial uniformities based on nearest neighbour analysis" (Hodder and Orton, 1976, 4). As an illustration they derive four point distribution maps generated from a random numbers table. They then demonstrate that in all four maps "we can identify a structure even though the pattern is random". Their conclusion: "These examples serve to underline the dangers of a non-rigorous approach to map analysis and interpretation when, as with archaeological data, little is known of the spatial process which produce the pattern" (Hodder and Orton, 1976, 6).

Unfortunately, the conclusion from the above examples is not all that unequivocal, since the above distribution maps can be used to demonstrate that a rigorous approach such as nearest neighbour analysis can obscure a genuine pattern otherwise obtained by a conventional "eye ball" interpretation. Some of these limitations have been summarized in the archaeological literature by Hodder and Orton (1976), and by Pinder, Shimada and Gregory (1979). For our purpose consider the limitations of linear clustering and partial clustering. They result since nearest neighbour analysis defines randomness over a two dimensional space. Consequently, a set of points clustered along a main road, for example, will be defined by nearest neighbour analysis as randomly distributed. Inference made on the basis of the statistical test might obscure, in some cases, genuine structures observable in these patterns. This is very much the case with Hodder and Orton's first example (1976, Fig. 1.2), where we can observe various linear clusters, which in real archaeological situations would justify some further investigations. Hodder and Orton's second to fourth maps expose yet another problem. Since nearest neighbour analysis is designed to produce a single measure for many points distributed over a two dimensional space, different genuine structures which exist simultaneously will be averaged out into randomness.

There are ways, of course, to overcome some of the limitations of the nearest neighbour test, simple observation being one of the most effective. In fact, it has been established ex-

perimentally that the visual map interpretation has a high degree of objectivity (Jenks, 1975). Hence the nearest neighbour test need not be abandoned, but should rather be considered one means of interpreting point distribution maps. There are other ways, some statistical and some "conventional", but none of these should be dismissed a priori. (After all, conventional "eye ball" map interpretation is no more subjective than the "rule of thumb" of 0.05, 0.01 and even 0.001 "significance levels". See Guttman, 1977-8). The main advantage of introducing quantitative-statistical methods is not that they are better than simple eye observation, but that they are different. They provide more ways of looking at our data. They are especially effective methods when we have to repeatedly apply the same measure to a large quantity of data, but they might prove rather weak if, for example, unquantifiable components are relevant for explanation. In fact one of the "dangers" of quantitative explanation is, as Christaller has noted, that it is too often associated with a tendency to ignore non-quantifiable factors altogether. Hodder and Orton quote King (1969, 43) that: "... a simple model such as the Poisson law hardly is suggested by theory... it is almost certain that other probability models could be found which would fit the observed facts equally well " (Hodder and Orton, 1976, 8).

Their response to King's challenge is to look for "better techniques", such as "random or stochastic processes". But as Richards (1979, 7) has noted: "The stochastic model in itself provides no explanation of causal mechanisms, but may relate to additional theoretical information to give a quantitative, mathematical summary of a qualitative explanation of the structure of the series". The point to emphasize is that a statistical-probabilistic "explanation" by itself is not capable of socio-economic explanation, even with increasing sophistication; the two do not always coincide. A statistical-probabilistic "explanation" is a technical-mathematical term, lacking any socio-economic meaning. In this connection Guttman pointed out that:

"... many ... misconceptions persist in current textbooks and journals because of some extraordinarily poor terminology ... Mathematicians are accustomed to dealing properly with arbitrary and even misleading symbolization, since they are trained in focus directly on the concepts being denoted and which are otherwise well defined. Not so are non-mathematicians, who instead are prone to react to verbal labels as having meaning apart from and beyond the designated technical concepts" (Guttman, 1977-8, 81).

Explanation of society must start with society, the law underlying its structure and by explicit consideration of social relations. The statistical-probabilistic model of explanation was applied to geography from the physical sciences and has been termed "social physics" (Wilson, 1970). But while in the physical sciences this mode of explanation is justifiable, the situation is different in the social sciences. (King, 1976, 302). And while it might be tempting to transform population into mass and social relations into energy (as in gravity models), the reverse transformation is not always obvious: "... abstract models, indices, eigen values, variables and principal components must all be translated back into flesh and blood" (Jones 1973, 167).

One interesting characteristic of location theory is that it was almost exclusively derived from economic theory. This is not an accident. In the writing of classical location theorists one finds references to other, non-economic, theoretical attempts. The fact is that the economic stream was capable of providing theoretical explanation while social physics was not. Furthermore, since the quantitative revolution in geography, most efforts have been directed toward statistical-probabilistic explanation, with the greatest emphasis on social-physics. Yet all these, despite their sophistication, have proved less effective in providing explanation than the more traditional economic approach. The reason is that economic theory, despite all the justified criticism, is a social theory. It explicitly considers human relations as they are and not as mass, gas or energy. Batty (1979) is therefore right when he concludes "ten years of urban modeling in Britain" by pointing out that the most remarkable achievement was the

demonstration that the entire family of negative exponential models can be related to economic theory. The reason is clear: by so doing, it was finally possible to transform a sterile mechanistic theory into a social theory.

The Socio-Economic and Political Frames

It has been noted that because of the emphasis of classical and modern location theory on present capitalistic society, the theory is not instantly applicable to archaeology. The consequences of the attachment of location theory to capitalism and perfect competition did not escape archaeologists (Johnson, 1975, 1977; Smith, 1976, 1976a). But instead of explicitly facing the problem the usual procedure was simply to evade it. For example Smith's (1976a) simply channeled the discussion to the dead-end of the century old controversy between substantivists and formalists. But the question is not whether the principles of economics are of universal validity. For even if it is accepted that "the market" is capable of universal explanation, there would still be a need to calibrate it into the specific historical-cultural framework studied. The most obvious example is the analysis in modern neo-classical economics of market (capitalistic) versus planned (communist) economies (Musgrave, 1969). Furthermore, there is no general agreement among neo-classical economists regarding the actual operation of the market and its consequences and obviously their perspective differs markedly from marxist economists or Galbraithians.

Location theories were formulated not only within the abstract market principles (self-interest, maximization, etc.) but also within "the elements of a capitalistic theory — such as, freedom of supply, freedom of consumption, and free mobility" (Christaller, 1966, 134), as well as uniform income distribution. As an illustration consider the main steps in the derivation of the Löschian system of central places: The first step is the "isotropic plane", which together with the assumption of perfect competition, create a totally equal society, politically and economically. Secondly, the spatial demand cone is derived from the isotropic plane. There is the only demand extant over the uniform plane and it emerges in response to the equal wants of each individual. The next step is filling the region with hexagonal market areas. This is not a "natural" process which can be derived directly from the spatial demand cone, but results from two exogeneous conditions imposed by Lösch upon his uniform plane in order to ensure full coverage. The first requires that all the population must be served and the second concerns the economic efficiency of movement, that is, the total aggregate movement must be minimized (and not for example the equal movement of each individual). It is through the above two conditions, and an implicit constraint on free migration, that the familiar hexagonal regional organization is created. Unless one imposes an economic or institutional constraint on free movement, the consequence of the spatial demand cone would be a redistribution of real income, which in turn entails densely populated served regions as against unserved regions with relatively low population density (Portugali, 1976, 1980).

In a stratified society some portions of the population are not capable of creating effective demand (which is a function of income, taste and political right); even if one could represent social relations in terms of demand, supply, economic efficiency, competition, etc., the resultant spatial theory would completely differ from classical and neo-classical location theories, even if we end up with similar spatial patterns.

From the above we cannot accept Johnson's (1975, 288) suggestion for solving the capitalist bias of location theory by stripping the theory from its socio-economic-political bounds and considering only the "universal" elements embodied in it, such as agglomeration, movement minimization and variable accessibility. In the first place agglomeration is not an elementary initial condition, but an outcome of demand and supply in specific spatial conditions. Lösch, for example, derives an agglomeration of economic activities by rotating his

system of production points in such a way as to maximize economic efficiency, i.e., the total aggregate movement. Similarly, variable accessibility of locations is an outcome of specific economic maximization rules and the process of agglomeration, and cannot be an initial condition of the model. The aim of location theory is to *explain* agglomeration and variable accessibility.

But the crucial point is that the initial elementary principles from which we derive the theory must be the principles of the society we are analyzing. Given movement minimization as an initial principle, the crucial question is whose movement is being minimized — the total aggregate? — the average equal movement of each individual? — the movement of a particular social class?

Johnson's approach of building a location theory on the basis of some *assumptions* about the general nature of human behaviour, was borrowed from geographical locational analysis which, in turn, borrowed it from neo-classical economics. This method has proved ineffective for geography, since the nature of the data is such, that different socio-economic-spatial processes may result with the same spatial pattern. Consequently, not only was central place theory, for example, "based on a theory of demand which Clarkson (1963) has shown is inherently unstable with reference to empirical evidence" (Harvey, 1969, 138), but one also could not trust the spatial data as the sole source to verify the theory. On top of this add the difficulty that empirical tests of central place theory "have shown that actual spatial patterns do not conform to the theoretical expectation" (Harvey, 1969, 138).

While the above situation "has proved a major dilemma in human geography" (Harvey 1969, 138), its consequences in archaeology are far reaching since our archaeological data about point distribution of settlements is severely distorted, our data about size distribution is incomplete (to say the least), and usually we have no (or almost no) information about spatial interaction. These three categories of data are the minimum required to test the validity of central place theory and other location theories (Portugali, 1980). It follows that in archaeology we are left with a spatial theory which, on the one hand, is derived from untestable assumptions about general principles and, on the other hand, cannot be supported experimentally.

CONCLUSIONS

Consequent to the critical review in geography, there are now attempts to look for methodological alternatives to positivism, to reconsider basic assumptions and to look at the whole location process with a wider historical and cultural perspective. We see attempts to conceptualize the location problem within the frame of Levi-Strauss's structuralism (Harvey, 1973; Friedmann, 1972, 1973), or Althusser's conception of structuralism (Gregory, 1978), as well as Sartre's existentialism (Olsson, 1975). We also see emerging interest in questions of urban origin (Harvey, 1973; Carter, 1977), and the implications for present urbanization processes in developing countries (Friedmann and Wulff, 1976). The whole question of "time" within a spatial context is being reconsidered (Thrift, 1977a, 1977b). These attempts to break out of the traditional conceptualizations of location theory refer mainly to the geographical location theory of the quantitative age. The original theories, as noted above, had a cultural-historical depth not found in subsequent literature. Hence, while the "limited success" of archaeological locational analysis can be attributed to the too simplistic nature of the geographical-quantitative location theory, the application of location theory to archaeological-anthropological material has the potential to revive the original nature of location theory.

While it is very unlikely that archaeology will ever have the amount of empirical spatial data possessed by geographers, it nevertheless has a much better basis to provide sound general principles from which location theory can be derived. Since as Dobb noted some 30 years ago,

in relation to neo-classical economics:

" The point is that such general principles can only properly emerge as a result of prior classification and analysis of the concrete peculiarities of particular situations, and not as a result of isolating a few common features of those situations by a method of superficial analogy ... In Friedrich Engels' words, ... Political Economy as an "historical science" "must first investigate the special laws of each separate stage in the evolution of production and exchange, and only when it has completed this investigation will it be able to establish the few quite general laws which hold good for production and exchange considered as a whole" (Dobb, 1978, 31, Orig. 1947).

Here is the central challenge for archaeological location theory: historical and cross-cultural analysis of the interrelationship between social structure and spatial form. Given a specific spatial structure, what society does it reflect? does the settlement pattern express the best way to serve all the population? Is it a result of a pure capitalistic society which minimizes the total aggregate movement? is it the most efficient pattern for tax collection — the movement minimization of the ruling class of a highly centralized society? And since societies do not exist in a vacuum, we must look at the confrontation, over time and space, between different societies and their changing spatial structure. What spatial expression results from the confrontation between rural, urban and nomadic societies, between town and country, industrial and non-industrial societies? Furthermore, space by definition implies spatial inequalities which may have played a role in the formation of societies. Thunen has shown how space affects agricultural land use which in turn affects land rent. What was the role of variable potentiality of land rent on the formation of social structure?

In order to be able to answer these questions location theory in geography and archaeology must consider them explicitly, even if it necessitates sacrificing elegant quantitative representation. Instead of deriving the theory from ostensibly "pure", "natural", "objective", "physical" rules supposedly characterizing every spatial pattern, human and non-human, one would be better off looking at the dynamics of social rules and laws.

Archaeology and anthropology are no longer obliged to "apply" locational analysis and theory. Most technical instruments developed in geography are today mastered by archaeologists and the way is open for theoretical explanation. What is needed is that archaeologists acknowledge the problematics of locational analysis exposed by the geographical criticism, and adapt this whole methodological-theoretical body to the specific nature of the archaeological material. With their rich historical and cultural data, archaeologists have the option to become full partners in advancing location theory.

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